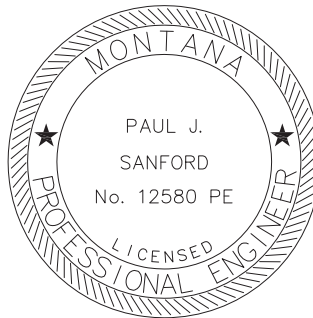


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TECHNICAL SPECIFICATIONS
CHADBOURNE DIVERSION, FWP #12-17

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Paul J. Sanford

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SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.1. DESCRIPTION

The Chadbourne Diversion Retrofit and Fisheries Enhancement Project is located approximately 4.6 miles southeast of Clyde Park in Park County, Montana. Photos showing the existing structure are included at the end of this specification. The project generally consists of the retrofit of an existing concrete irrigation diversion weir to improve stability and provide a fish barrier ~~and construction of a fish trap to allow sorting and selective upstream passage of Yellowstone Cutthroat trout.~~ The work will be divided between the Contractor and the Owner. Work to be completed by the Owner includes:

Work to be performed by the Owner includes:

- Acquiring the Permits Listed in the Specifications.

The bid will be awarded based on the BASE BID and, potentially, any combination of ALTERNATE BIDS that is determined to be within FWP's budget and in the best interests of FWP and the Lower Shields River Canal Company.

1.2. MATERIAL SUPPLIED BY OWNER

No material will be supplied by the Owner.

1.3. FIELD QUALITY CONTROL

- A. Allied Engineering Services, Inc. will perform periodic site visits to inspect work and provide confirmation of crucial design elements.
- B. Specifications and drawings included in these contract documents establish the performance and quality requirements and establish minimum standards for workmanship and appearance.

END OF SECTION







SECTION 01300 SUBMITTALS

PART 1: GENERAL

1.1 DESCRIPTION

This Section outlines in general the items the Contractor must prepare or assemble for submittal prior to and during the progress of the work. There is no attempt herein to state all of the procedures and requirements for each submittal. The Contractor's attention is directed to the individual Specification Sections that may contain in detail additional and special submittal requirements. The Owner's Representative reserves the right to direct and modify the procedures and requirements for submittals as necessary to accomplish the specific purpose of each submittal. Should the Contractor be in doubt as to the procedure, purpose, or extent of any submittal, he should direct his inquiry to the Owner's Representative.

The Contractor will furnish Submittals for any and all such parts of the Work as set forth in the Specifications. The procedures for review of the submittals will be as follows:

1. The Contractor will submit to the Owner's Representative for his review, sets of drawings, material specifications, or requests for information. Contractor will submit these documents electronically to the Owner's Representative at both paul@alliedengineering.com and Mmcnearney@mt.gov. Contractor will also submit two (2) sets of printed documents to the Owner's Representative by hand or mail delivery.
2. When a drawing or material specification is satisfactory to the Owner's Representative, one hard and one electronic version will be returned to the Contractor and will be dated and marked, "Approved as Corrected" or "Approved as Submitted".
3. Should a drawing or material specification be unsatisfactory to the Owner's Representative, he will mark thereon "Revise and Resubmit", or "Rejected", and will return one hard and one electronic version to the Contractor with the necessary corrections and changes indicated. The Contractor must make such corrections and changes, and again submit the drawings or specifications for approval. The Contractor will revise and resubmit the working drawings or specifications until satisfactory review by the Owner's Representative is obtained.
4. The Contractor will allow sufficient time for preliminary review, correction, resubmission, and final review of all working (shop) drawings. Drawings of items critical to job progress will be given priority review by the Owner's Representative.

PART 2: PRODUCTS – NOT USED

PART 3: EXECUTION

3.1 GENERAL

Items for which submittals will be required include but are not limited to:

1. Plans

| Plan | Section |
|-------------------------------|---------|
| Overall Construction Schedule | 02100 |
| Control of Water Plan | 02230 |

2. Materials

| Item | Section |
|---------------------------------------------------------------|---------------------------------|
| Erosion Control Fabric | 02220 |
| Straw Wattle | 02220 |
| Flowable Fill | 02225, 02500 |
| Structural Backfill | 02300, 02500 |
| Fish Trap Structure (Not in This Contract) | 02400 |
| Bedding Material | 02400, 02500 |
| Reinforcing Steel | 02400, 02500, 03210 |
| Structural Concrete | 02400, 02500, 03310 |
| Fish Screens | 02400 |
| Canal Gates | 02400, 02750 |
| Transport Pipes | 02400, 02725 |
| Hook Step Ladder | 02400 |
| Covers for Fish Trap Structure | 02400 |
| Geotextile Fabric | 02500 |
| Irrigation Diversion Hardware | 02500 |
| Portage Signs | 02500 |
| Rock | 02600 |
| Geotextile Fabric for Subgrade Separator in Step Pool Channel | 02600 (Not in This Contract) |
| Coir Fabric | 02600 |
| Topsoil | 02700 |
| Seed | 02710 |

Not in This Contract

3.2 SAMPLES AND TEST SPECIMENS

Where required in the Specifications, and as determined necessary by the Owner's Representative, test specimens or samples of materials to be used or offered for use in connection with the Work will be submitted to the Owner's Representative, at the Contractor's expense, with information as to their sources, with all cartage charges prepaid, and in such quantities and sizes as may be required for proper examination and tests to establish the quality or equality thereof, and to determine conformance to the Specifications as applicable.

All samples and test specimens will be submitted in ample time to enable the Owner's Representative to make any tests or examinations necessary without delay to the work. The Contractor will be held responsible for any loss of time due to his neglect or failure to deliver the required samples and test specimens to the Owner's Representative, as specified.

The Contractor will submit additional samples and test specimens as required by the Owner's Representative to assure equality with the original approved sample and/or for determination of Specification compliance.

3.3 RECORD DRAWINGS

The Contractor will maintain one set of Plans on the jobsite, designated "Record Drawings". The Contractor will contemporaneously maintain the Record Drawings in a condition that reflects the current status of the construction work. The Record Drawings will be available to the Owner's Representative for inspection and copying during the progress of the work. All markings will be neatly performed with red pencil.

The Record Drawings will be marked up as required to show all deviations from the original contract drawings including changes resulting from minor field adjustments, field orders, and Contract Modifications. Changes should be drawn after the respective construction work is completed and all new locations, dimensions, and elevations will be shown. Where larger scale presentation is required, the Contractor will prepare additional drawings and attach them to the appropriate prints.

At the completion of the work but before Substantial Completion, the Record Drawings will be submitted to the Owner's Representative.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

No measurement will be made for Submittals.

4.2 PAYMENT

The work specified in this Section will be considered incidental and no separate payment will be made for Submittals.

SECTION 02100 SCHEDULE AND SEQUENCE OF OPERATIONS

PART 1: GENERAL

1.1 DESCRIPTION

The work will be performed at such times and in or on such parts of the project and with such forces, materials and equipment to prevent any delay to the completion of the project within the time limits stated in the Contract and in conformance with the Overall Construction Schedule specified herein.

1.2 PRE BID CONFERENCE

A pre bid conference will be held at the location and the time identified in the Invitation to Bid. The pre bid conference is not mandatory but is recommended.

1.3 PRECONSTRUCTION CONFERENCE

Before beginning the work and after the Contract has been awarded, the Owner's Representative will conduct a Preconstruction Conference to discuss the Contractor's schedules and the Contractor's procedures, development of a plan for site protection and reconstruction, Contractor's use of the site, Owner's regulations, regulatory permit requirements, landowner requests, and other matters deemed relevant to the effective performance of the work.

The conference will be attended by the Contractor's Authorized Representative and any subcontractor's or supplier's representatives whom the Contractor may desire to invite or the Owner's Representative may request.

1.4 PROJECT DURATION

The project will have a ⁶⁰~~75~~-day duration based on calendar days. All construction will be completed in ~~2012~~.
²⁰¹³.

PART 2: PRODUCTS – NOT USED

PART 3: EXECUTION

3.1 OVERALL CONSTRUCTION SCHEDULE

In-stream excavation and major ground disturbance, including grading and excavation immediately adjacent to the river, will occur during the period of August 15 – November 15. Work outside of this timeframe will be by approval of the Owner's Representative. Work occurring prior to October 1 will be coordinated with the Lower Shields River Canal Company so as to not disrupt their irrigation diversion practices.

Construction may be delayed based on weather conditions.

3.2 SEQUENCING

Construction activities will take place in a sequence determined by the Contractor. Specific sequencing requirements are included in the following specifications sections:

- 02110 Mobilization
- 02112 Construction Staking
- 02115 Site Access and Staging Areas
- 02120 Clearing and Grubbing
- 02210 Protection of the Environment
- 02220 Erosion Control
- 02230 Control of Water
- 02240 Demolition
- 02300 Earthwork
- 02500 Fish Barrier Structure
- 02600 Channel Construction
- 02700 Topsoil
- 02710 Seeding
- 03310 Structural Concrete

3.3 SUBMITTALS

The Contractor will prepare and submit to the Owner's Representative, within 7 days after the Notice to Proceed, his Overall Construction Schedule (Overall Schedule). The Overall Schedule will be comprised of preparatory and construction operations covering all work to be done in connection with the Contract. The Overall Schedule will include:

1. Anticipated project start and end date
2. Implementation and maintenance of Erosion Control measures
3. Implementation of Control of Water measures
4. Main construction phases
5. Dates of placing Concrete
6. Dates of Seeding

The Contractor will submit to the Owner's Representative a revised and updated Overall Schedule, based on work progress to date, every two weeks after the construction has commenced (on the 1st and 16th of each month following the initial submittal of the Overall Schedule). The revised Overall Schedule will be submitted to the Owner's Representative in electronic and hard copy formats.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

No measurement will be made of activities associated with Schedule and Sequence of Operations.

4.2 PAYMENT

No payment will be made for Schedule and Sequence of Operations.

SECTION 02110 MOBILIZATION

PART 1: GENERAL

1.1 DESCRIPTION

This section covers the work necessary to mobilize and demobilize for the construction including, but not limited to, providing bonds, insurance, permits, and licenses; setting up and taking down temporary sanitary facilities; moving equipment and materials to and from the site; and preparation of the site for construction as specified and shown on the Plans.

PART 2: PRODUCTS

2.1 GENERAL

The Contractor will provide all temporary facilities required for performing the work. Temporary construction facilities are solely the Contractor's responsibility based on his selected method of operation and schedule.

PART 3: EXECUTION

3.1 GENERAL

Set up construction facilities in a neat and orderly manner within areas designated by the Owner. Accomplish all required work in accordance with applicable portions of these specifications, or as approved. Confine operations to the approved work area.

Remove all construction facilities and return the areas used for that purpose to the original condition, including, as necessary, clean-up, material removal, soil de-compaction, and installation of erosion control measures, as directed and approved by the Owner.

3.2 EQUIPMENT CONDITION

- A. All equipment will be in good working condition in order to minimize the risk of major component failure while working within the stream or lake. The Contractor will take all reasonable practices to protect the river as the work is being completed.
- B. As a means of preventing the introduction of undesirable vegetation (noxious weeds) to the project site, as well as preventing the introduction of oil and grease to the river, all heavy equipment working within the project area will be steam-cleaned prior to entering the project area. Personal vehicles will be parked in an area where soils are not disturbed. Vehicles transporting materials to the site are exempt from this requirement.

- C. All equipment on-site will be inspected daily for any fluid leakage prior to entering the stream.
- D. Any leakage found will be repaired before the piece of equipment is allowed to return to work.
- E. Any fluid leakage within the river will be reported to the proper authorities. If any spillage or environmental contamination occurs as a result of Contractor negligence, the Contractor will provide clean-up to the satisfaction of all Permitting Authorities at no additional cost to the Owner.
- F. All refueling and maintenance will be performed outside of the river.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

No measurement will be made for Mobilization.

4.2 PAYMENT

Payment for the work specified in this section will be made based on the lump sum amount stated in the Bid. Payment for 80% of the amount of this bid item will be made following implementation of mobilization and setup activities. Payment for the remaining 20% of the amount for this bid item will be made following completion of demobilization and cleanup activities.

SECTION 02112 CONSTRUCTION STAKING

PART 1: GENERAL

1.1 DESCRIPTION

This specification covers the furnishing of all labor, materials, tools and equipment necessary to perform construction staking. The Owner will be responsible for one-time initial construction staking. The Contractor will be responsible for any additional staking required and for replacing stakes removed, damaged or destroyed due to Contractor activities at no cost to the Owner.

PART 2: PRODUCTS

2.1 GENERAL

Wooden stakes and lath for reference staking will be labeled with the appropriate information (station, offset, elevation, location, etc.).

Plastic flagging will be brightly colored or fluorescent plastic ribbon securely tied to the survey stake. Plastic flagging that becomes faded, torn or dislodged will be replaced at the Contractor's expense.

Paint, when used in lieu of plastic flagging to mark survey stakes, will be brightly colored or fluorescent to be visible from passing equipment. Paint that becomes faded will be remarked or reset at the Contractor's expense.

PART 3: EXECUTION

3.1 GENERAL

The Owner will provide one-time staking of alignments and other key features as described in Section 3.2. The Contractor is responsible for providing any additional staking or re-setting of disturbed stakes.

All errors and discrepancies found on the construction stakes, plans, or specifications will be called to the attention of the Owner's Representative by the Contractor prior to proceeding with further survey and construction work. Any deficient survey layout or staking performed by the Contractor, or any unreported errors in previous surveys that may result in construction errors, will be corrected by the Contractor at no additional cost to the Owner.

3.2 CONSTRUCTION STAKING PROVIDED BY OWNER

The Limits of Disturbance will be staked.

The horizontal alignments shown on Plan Sheet H-1 will be staked. Where alignments are located in water, an offset will be provided. Staking points consisting of wooden stakes and metal spikes will be provided at the alignment beginning point, points of intersection of lines, 100-foot station increments, and the alignment end point.

The horizontal alignment and elevations of the Concrete Ogee Spillway, Concrete Apron and the Scour Hole Rock Armor will be staked with offset cut/fill stakes.

The horizontal alignment and elevations of the Fish Trap elements including the following will be staked with offset cut/fill stakes: Intake Box; Energy Dissipation Box; Transport Channel; V-Trap; and Step Pool Channel.

Not in This Contract

3.3 SURVEY CONTROL

Survey control benchmark locations and coordinates are provided on Plan Sheet H-1. The Contractor will protect survey control benchmarks. The Contractor is responsible for re-setting of disturbed benchmarks.

3.4 SURVEY TOLERANCES

Tolerances for staking rock placement and for earthwork will be ± 1 foot horizontal and ± 0.1 feet vertical. Tolerances for staking all other project elements including structural concrete will be ± 0.01 foot horizontal and ± 0.01 feet vertical.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

No measurement will be made for Construction Staking.

4.2 PAYMENT

Construction Staking will be considered incidental to other work items. No payment will be made for Construction Staking.

SECTION 02115
SITE ACCESS AND STAGING AREAS

PART 1: GENERAL

1.1 DESCRIPTION

The Work covered by this Section includes the furnishing of all labor, materials, equipment and incidentals for construction, installation, protection and maintenance and reclamation of:

1. Site Access; and
2. Staging Areas.

PART 2: PRODUCTS

2.1 DESCRIPTION

If necessary, the Contractor will provide road surface material at the approval of the Owner.

PART 3: EXECUTION

3.1 GENERAL

At a minimum, the site access and staging areas will include appropriate standard erosion control best management practices (BMPs).

3.2 SITE ACCESS

Primary access to the project is from Highway 89 via an unimproved two-track road within a Park County easement through private land. Secondary access to the project is from Shields River Road East via an unimproved two-track road on private land. Refer to Plan Sheet T-1 for the location of the access roads. The access roads will be returned to the original condition upon completion of the project at the Contractor's expense. Returning to original conditions may involve resurfacing the access road.

The access roads will be occasionally used by the Lower Shields River Canal Company to provide access to the Chadbourne Diversion and by the owners of the private land. Care should be taken to ensure safety of vehicle and pedestrians. The Contractor will coordinate with the Owner's Representative to establish a suitable plan to provide access while minimizing disruption of construction traffic.

During construction of the project, the primary access road will be graded and maintained so as to provide access to 2-wheel drive vehicles.

3.3 SITE ACCESS IN NON-ROADED AREAS

- A. The Contractor will provide methods to install, maintain, and remove the Site Access in Non-Roaded Areas so as to minimize impact to the surrounding landscape.
- B. Contractor will be responsible for maintaining function of the Site Access in Non-Roaded Areas during use.
- C. The Contractor will be responsible for maintaining site drainage during construction and restoration while Site Access in Non-Roaded Areas is used.
- D. Upon completion of the project, the Contractor will be responsible for removing the Site Access in Non-Roaded Areas and returning the area to a natural state. The Contractor will remove the access road materials, dispose of the access road materials, apply topsoil, and re-grade the areas to match the existing grade according to the Specifications.

3.4 STAGING AREAS

- A. The Contractor will provide methods to install, maintain, and remove the Staging Areas so as to minimize impact to the surrounding landscape.
- B. Contractor will be responsible for maintaining function of the Staging Areas during use.
- C. The Contractor will be responsible for maintaining site drainage during construction and restoration while the Staging Areas are used.
- D. The location and dimensions of the Staging Areas will be within the area marked on the Plans that depicts the limits of disturbance.
- E. Upon completion of the project, the Contractor will be responsible for removing the Staging Areas and returning the areas to a natural state. The Contractor will scarify the surface (harrow rake) and apply seed.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

No measurement will be made for Site Access and Staging Areas.

4.2 PAYMENT

No Payment will be made of activities associated with Site Access and Staging Areas. The cost for Site Access and Staging Areas is incidental to Mobilization.

SECTION 02120 CLEARING & GRUBBING

PART 1: GENERAL

1.1 DESCRIPTION

This work is the clearing, grubbing, removing, burning, burying, and disposing of vegetation and debris within the project limits without damaging vegetation, adjacent property and other objects designated to remain in place. Immediately stop work and notify the Owner's Representative if evidence of aboriginal activity or occupation is encountered.

Clearing: Clearing is felling trees, disposing of stumps, brush, windfalls, logs, limbs, sticks, piles of sawdust, rubbish, debris, vegetation, and other matter within the clearing limits or other areas that interfere with excavation and earthwork limits.

Grubbing: Grubbing is removing and disposing of roots, stumps, stubs, duff, matted roots, and debris from the grubbing limits.

Disposal: Disposal is removing, burning, and burying the accumulations from clearing, grubbing, or clearing and grubbing operations meeting all Local, State and Federal laws and regulations.

Salvage: In areas that will be disturbed, salvage live willows in sufficient quantity to allow replacement on the low streambank where the right bank of the step pool channel ties into the low bank. During the project, store willows with root masses in mulch and keep wet for duration of construction.

PART 2: PRODUCTS – NOT USED

PART 3: EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

Limit dragging, piling, disposing of debris, and other work to areas to be excavated or covered by earthwork. Do not damage or destroy vegetation not designated to be removed. Do not injure or damage adjacent vegetation unless designated for removal in the Plans. Replace damaged or destroyed vegetation designated to be preserved at Contractor expense.

Protect live root systems adjacent to, but outside of, the clearing limits. Close-cut and remove potential hazards, such as leaning trees (alive or dead), and snags within the project area as designated by the Owner's Representative.

The Owner's Representative will stake the construction limits for access and clearing and grubbing to establish limits. Other staking is addressed in Section 02112 Construction Staking.

3.2 CLEARING

Clear only within the staked construction limits and only to the degree necessary to allow construction of the project. Cut off trees, stumps, brush, shrubs, and other vegetation to within 6-inches of the ground. Fell trees without endangering or injuring trees or objects not designated for removal.

Tree branches and limbs, rootwads and other organic debris will be removed from the site unless the Owner's Representative allows spreading of the material on-site.

3.3 GRUBBING

Grub only within the staked construction limits. Remove all stumps, roots, logs, timber more than 3-inches in diameter, and all brush, matted roots, and other debris within the grubbing limits to at least 6-inches below the original ground surface. Where structural fill is to be placed, remove all organic material irrespective of depth.

3.4 MATERIAL DISPOSAL

Dispose of material from operations offsite to meet all Local, State and Federal requirements at Contractor expense.

A. Burning. Burn materials meeting the State of Montana Open Burning Regulations administered by the Air Quality Bureau of the Montana Department of Health and Environmental Sciences, and all other applicable Local, State and Federal rules and regulations. The general requirements of the Montana Open Burning Regulations regarding burning season and permits are described below.

1. Permits. When burning near public lands during the fire season (May 1 through September 30, or as extended), obtain a burning permit from the Local, State or Federal fire protection agency having jurisdiction.
2. Open Burning Season. The open burning season for forestry slash is from March 1 through November 30. Open burning is not allowed during December, January, or February. Burning from September 1 through November 30, on a day to day basis is subject to ventilation conditions available from the Air Quality Bureau, at 1-800-225-6779. Obtain the ventilation conditions daily before burning.
3. Burning Methods and Instructions. Burning by the Air Curtain Destructor or Forced Air methods are encouraged. Obtain the Project Manager's approval for burning pits located within the right-of-way limits. Dispose of all pits, ashes, and debris meeting area regulations.

Locate burning pits at least 100 feet from free-flowing water or areas where ditches are to be constructed. Locate pits and incinerators to prevent

any fire damage or hazard to surrounding vegetation or structures. Contact local fire protection agencies before the start of any burning. Provide 24 hour monitoring of all burning.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

No measurement will be made for Clearing and Grubbing.

4.2 PAYMENT

No Payment will be made of activities associated with Clearing and Grubbing. Merge the costs of Clearing and Grubbing with applicable Bid Items.

SECTION 02210
PROTECTION OF THE ENVIRONMENT

PART 1: GENERAL

1.1 DESCRIPTION

This Work consists of protecting existing soils and subsoils, ground topography and drainage, herbaceous and woody vegetation, and fish and wildlife during the implementation of the project.

PART 2: PRODUCTS – NOT USED

PART 3: EXECUTION

3.1 GENERAL

To mitigate potential impacts to the environment, the Contractor will use appropriate Erosion Control practices on the site. The following general practices will be employed, where applicable:

- A. The smallest practical area of land will be exposed at any given time through construction scheduling. The duration of such exposure before application of temporary erosion control measures or final revegetation will be as short as practicable.
- B. Proceed carefully with construction adjacent to stream channels to avoid washing, sloughing, or deposition of materials into the stream.
- C. Avoid removal of trees and surface vegetation wherever possible.
- D. Take measures to prevent erosion from spoil or topsoil stockpiles such as covering with tarpaulins, or plastic.
- E. No construction, except for that associated with erosion control measures, will occur when excessive precipitation is expected in the immediate future, during periods of heavy precipitation or high stream flow.
- F. Erosion control measures must be in place at the end of each working day.
- G. Periodic inspection, repair, and maintenance of erosion control measures are required until the project is completed. Inspection and maintenance must occur after each rain event exceeding ½-inch rainfall or at least once each week.
- H. Contractor must allow free and unlimited access to the project site at any time to any Regulatory agency employee investigating the project's construction, operation or maintenance.

- I. Construction related disturbance is anticipated to be less than 1-acre. If contractor calculates disturbance limits to exceed 1 acre, Owner will be notified. The Owner will apply for the Montana Department of Environmental Quality (MDEQ) General Permit for Stormwater Discharges Associated with Construction Activity (NOI and SWPPP).

All purge water from dewatering operations shall be land applied to the same aquifer from which the water was taken. If sediment-laden water is land-applied and will not reach state water, then a discharge permit is not required (e.g. sediment-laden water will infiltrate into the ground or be used for irrigation through a sprinkler system). If the Contractor desires to route purge water to surface water, a Construction Dewatering Discharge Permit must be obtained from MDEQ. It shall be the Contractor's responsibility to apply for a Construction Dewatering Discharge Permit. No payment will be made to Contractor for obtaining and complying with this permit. Permit application fee is approximately \$900 or as specified by MDEQ, and the estimated processing time is 10 to 30 days. Refer to the following website for information about the permit:

<http://deq.mt.gov/wqinfo/MPDES/ConstructionDewatering.mcp.x>.

The Owner will obtain the Floodplain Development Permit, Montana Stream Protection Act (124), Montana Department of Environmental Quality (318), and Federal Clean Water Act (404) permits. The Contractor will familiarize themselves with the conditions of the permits and will comply with the conditions of these permits. Contractor will keep a copy of all permits and approved plans at the project site at all times until the project is completed.

The Contractor will minimize disturbance of all roads used to provide equipment, material and labor access to the project site. Any road damage resulting from Contractor operations will be repaired by the Contractor, at no expense to the Owner, prior to issuance of Substantial Completion.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

No measurement will be made of activities associated with Protection of the Environment.

4.2 PAYMENT

No payment will be made of activities associated with Protection of the Environment.

SECTION 02220 EROSION CONTROL

PART 1: GENERAL

A. DESCRIPTION

The Work covered by this section includes the furnishing of all labor, materials, equipment and incidentals for construction and installation of:

1. Erosion Control Fabric on disturbed ground surfaces. Note – Erosion Control Fabric is a provisional Bid Item to be placed at locations directed by the Engineer; and
2. Straw Wattle along the contours of slopes.

PART 2: PRODUCTS

2.1 EROSION CONTROL FABRIC

Coir fabric is a biodegradable erosion control fabric made from the fibers of coconut husks. Woven coir fabric is used as erosion control of disturbed ground surfaces.

A. COIR FABRIC MATERIAL PROPERTY REQUIREMENTS

The woven coir fabric material will consist of 100% coconut fiber in continuously woven mat. The material will conform to the following values:

| | | |
|------------------------|------------|-----------------------|
| Thickness | ASTM D1777 | 0.30 in. (min) |
| Tensile Strength (dry) | ASTM D4595 | 60 x 60 lb./in. (min) |
| Mass Per Unit Area | ASTM D3776 | 13 oz./sy. (min) |
| Open Area | Measured | 65% (max) |

B. PREAPPROVED PRODUCTS

Woven coir fabric will be DeKoWe 400, Nedia KoirMat 400, Rolanka BioDMat 40 or approved equal. Do not order, deliver, or install other products without the written approval of the Owner's Representative.

C. SUBMITTALS

Contractor will provide the following submittals.

1. Name, address, and phone number of supplier(s) of all coir fabrics used on the project.
2. Technical Specification of the coir fabrics with associated testing standards with 8 by 10 inch samples in plastic bags.
3. Documentation of equivalency to products specified.

4. Manufacturer's shipping, storing, and placement recommendations.

2.2 STRAW WATTLE

Straw Wattles are elongated tubes of compacted straw and/or other fibers that are installed along contours or at the base of slopes to help reduce soil erosion and retain sediment. They function by shortening slope length, reducing runoff water velocity, trapping dislodged soil particles and ameliorating the effects of slope steepness.

A. STRAW WATTLE MATERIAL PROPERTY REQUIREMENTS

Straw Wattles will be a rice or wheat straw-filled tube of flexible netting material exhibiting the following properties. It shall be a machine-produced tube of compacted rice or wheat straw that is Certified Weed Free Forage, by a manufacturer whose principle business is wattle manufacturing. The netting shall consist of natural fibers (such as coir, burlap or cotton). Straw Wattle with plastic netting is not acceptable.

| | |
|----------------------|---------------------|
| Wattle Thickness | 8 in. (min) |
| Wattle Length | 10 ft. or greater |
| Fiber Content | Rice or wheat straw |
| Mass Per Unit Weight | 1.5 lbs/lf (min) |

B. PREAPPROVED PRODUCTS

Straw Wattle will be Earth Saver® Rice Straw Wattle (EE0825BRP-10 or EE0810BRP-24) with natural fiber (burlap) netting or approved equal. Straw Wattle with plastic netting is not approved. Do not order, deliver, or install other products without the written approval of the Owner's Representative.

C. SUBMITTALS

Contractor will provide the following submittals.

1. Name, address, and phone number of supplier(s) of the Straw Wattle used on the project.
2. Technical Specification of the Straw Wattle with associated testing standards.
3. Documentation of equivalency to products specified.
4. Manufacturer's shipping, storing, and placement recommendations.

2.3 WOODEN STAKES

Fabric stakes will be wooden stakes 12 inches long and 1 inch by 0.75 inches in diameter, or other dimensions as approved by the Owner's Representative. Fabric stakes will not be treated with preservative. Other types of stakes will be subject to the approval of the Owner's Representative. Metal pins or staples are not acceptable.

Preapproved stakes are Wooden Pegs from Rolanka International (www.rolanka.com) as long as they meet the dimension and length requirements in these specifications.

PART 3: EXECUTION

3.1 EROSION CONTROL FABRIC

- A. Place Erosion Control Fabric as directed by the Engineer.
- B. This section describes the placement of woven coir fabric as Erosion Control Fabric on all disturbed surfaces where bare soil is present.
- C. Seeding of disturbed surfaces will be carried out prior to installation of Erosion Control Fabric and in accordance with the specifications.
- D. Before placing Erosion Control Fabric, the surface on which it is to be placed will be prepared by removal of all sharp objects. All holes and large ruts will be filled with material. The surface will be reviewed by the Owner's Representative prior to placement of Erosion Control Fabric.
- E. The Contractor will handle the fabric in a manner that does not damage the fabric. Place Erosion Control Fabric rolling the fabric lengthwise, parallel to the channel. Erosion Control Fabric will be unrolled directly on the prepared surface.
- F. Erosion Control Fabric will be placed in parallel rows oriented in a downstream direction. End joints from one row to the next will be offset by a minimum of 10 feet. Fabric end joints will be overlapped in an upstream to downstream direction to prevent flowing water from dislodging the fabric. Fabric parallel joints will be overlapped in a near-channel to far-channel direction to prevent flowing water from dislodging the fabric. All joints between fabric rolls will consist of a minimum of 12 inches of fabric overlap.
- G. The Erosion Control Fabric will be even, smooth, and taut, such that the fabric is in direct contact with the underlying soil in all areas, and to the satisfaction of the Owner's Representative. Mechanical tightening may be required to remove slack.
- H. Install Wooden Stakes along all edges, overlaps and at intervals as specified herein or as approved by the Owner's Representative. Install Wooden Stakes at 4-foot spacing along all seams and key trenches and at 4-foot spacing within fabric rolls, staggered with respect to seams. Do not cut woven coir fabric to install stakes: thread stakes between fabric strands. With Owner's Representative's approval, stakes may be tilted up to 45 degrees with respect to vertical if underlying materials prevent vertical insertion. After insertion, stake tops will protrude 2 inches maximum above the adjacent fabric surface. Broken, split, or damaged stakes will be removed and replaced at the Contractor's expense.

3.2 STRAW WATTLE

- A. This section describes the installation of Straw Wattle on slope contours.
- B. Proper site preparation is essential to ensure complete contact of the Straw Wattle with the soil.
- C. The slope should be prepared to receive the surface mulching/re-vegetation treatment prior to installation of the Straw Wattle.
- D. Remove all rocks, clods, vegetation or other obstructions so that the installed Straw Wattles will have direct contact with the soil.
- E. Straw Wattle will be placed along the contours on disturbed slopes according to the following:
 - a. About 20 feet (diagonal or slope distance) apart on slopes between 3:1 and 2:1;
 - b. About 10 feet apart on slopes greater than 2:1; and
 - c. According to the Owner's Representative.
- F. Excavate a small trench (2-3 inches) in depth on the slope contour and perpendicular to water flow. Soil from the excavation should be placed down-slope next to the trench.
- G. Install the Straw Wattles in the trench, insuring that no gaps exist between the soil and the bottom of the Straw Wattle. The ends of adjacent Straw Wattles should be tightly abutted so that no opening exists for water or sediment to pass through. Alternately, Straw Wattles may be lapped, 6 inches minimum to prevent sediment passing through the field joint.
- H. Wooden stakes should be used to fasten the Straw Wattles to the soil. When conditions warrant, a straight metal bar can be used to drive a pilot hole- through the Straw Wattle and into the soil.
- I. Wooden stakes should be placed 6 inches from the Straw Wattle end angled towards the adjacent Straw Wattle and spaced at 4 feet centers 1-2 inches of stake exposed above the Straw Wattle. Alternately, stakes may be placed on each side of the Wattle tying across with a natural fiber twine or staking in a crossing manner ensuring direct soil contact at all times.
- J. Terminal ends of Straw Wattles may be dog legged up slope to ensure containment and prevent channeling of sedimentation.
- K. Care shall be taken during installation so as to avoid damage occurring to the Straw Wattle as a result of the installation process. Should the Straw Wattle be damaged during installation, a wooden stake shall be placed either side of the damaged area terminating the log segment.

- L. Any Straw Wattle damaged during placement will be replaced as directed by the Owner's Representative, at the Contractor's expense.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

- A. The quantity of Erosion Control Fabric will be the actual fabric surface treatment area, computed in square yards as the product of the measured length and width of exposed Erosion Control Fabric as seen in plan view, to the nearest 10 square yards. Overlapped fabric will not be measured for payment.
- B. Measurement of Straw Wattle will be by the lineal foot of continuous, material installed according to the specifications and Plans. Overlaps and joints will not be measured.

4.2 PAYMENT

- A. Payment for Erosion Control Fabric will be made at the unit price per square yard. The unit price per each square yard for Erosion Control Fabric will constitute full compensation for all materials, staking, labor, equipment, and incidentals necessary to furnish materials and for installation as specified in the specifications and on the Plans.
- B. Payment of Straw Wattle will be at the unit price per lineal foot. The unit price per each lineal foot of Straw Wattle will constitute full compensation for all materials, staking, labor, equipment, and incidentals necessary to furnish materials, installation as specified in the specifications and on the Plans.

SECTION 02225

FLOWABLE FILL

PART I: GENERAL

1.1 DESCRIPTION

- A. This work consists of furnishing and placing Flowable Fill to the lines and grades shown on the plans as backfill in trenches and/or at other locations. Flowable Fill is a self-compacting cementitious material using mineral aggregates (sand and/or gravel), native or processed materials, fly ash/cement, water, air entraining solution and (optionally) other admixtures. Flowable Fill is also known as Controlled Low-Strength Material (CLSM) and Controlled Density Fill (CDF). Flowable Fill is only permitted when specifically called out in the contract documents or approved by Engineer.

1.2 REFERENCES

- A. The current publications listed below form a part of the specification.

| | |
|------------|-----------------------------------------------------------------------------------------------|
| ASTM D4832 | Preparation/Testing of Soil-Cement Slurry Test Cylinders |
| ASTM C39 | Test Method for Compressive Strength of Cylindrical Concrete Specimens |
| ASTM D6023 | Standard Test Method for Unit Weight |
| ASTM C150 | Specification for Portland Cement |
| ASTM C618 | Specification for Fly Ash |
| ASTM C494 | Specification for Chemical Admixture for Concrete |
| ASTM E329 | Practice for Use in the Evaluation of Testing and Inspection Agencies as Used in Construction |
| ASTM C1064 | Temperature of Freshly Mixed Portland Cement Concrete |
| ASTM C117 | Materials Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing |
| ASTM C136 | Sieve Analysis of Fine & Coarse Aggregate |
| ASTM C117 | Materials Finer Than No. 200 (0.075 mm) Sieve in Mineral Aggregates by Washing |
| ASTM D4318 | Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils |
| ASTM C94 | Ready Mix Concrete |
| ACI 301 | Standard Specifications for Structural Concrete for Buildings |

1.3 TESTING

- A. The Engineer may perform occasional quality assurance tests on the flowable fill consisting of slump, air content measurements and casting three cylinders for compressive strength test. The required compressive strength test method and required range are described in section 2.4, Compressive Strength below.
- B. The Contractor is to provide the Engineer with a mix design by either trial batch or field experience methods to verify the required compressive strength of the flowable fill at the 28 day age. Mix design requirements are described in Section 2.3, Proportions; and in Section 2.4, Compressive Strength. Proportions shall be selected on the basis of unconfined, air cured compressive strength test specimens.

PART 2: PRODUCTS

2.1 MIXTURE OF MATERIALS

- A. Provide a mixture of the materials described below to produce a self-compacting cementitious material batched on a per cubic yard basis.

2.2 MATERIALS

- A. Portland Cement. Portland cement shall conform to the requirements of ASTM C150, Type 11.
- B. Fly Ash. Fly Ash shall conform to ASTM C618, Class C or F.
- C. Coarse Aggregate, Fine Aggregate and Native Materials. Any aggregate gradation which produces performance characteristics of the flowable fill specified herein will be accepted, except as follows: The amount of material passing the #200 sieve shall not exceed 20 percent. Also, liquid limit and plasticity index shall not exceed 25 and 5, respectively.
- D. Water. Water used in mixing shall be free of oil, salt, acid, alkali, sugar, vegetable matter or other substances injurious to the finished product.
- E. Chemical Admixtures. Chemical Admixtures shall conform to the requirements of ASTM C494.

2.3 PROPORTIONS

- A. A variety of sand/gravel aggregates, and/or native (or processed) materials meeting the above requirements in conjunction with appropriate amounts of Portland cement and flyash, air entraining solution, and (optionally) other admixtures may be used to produce the required mix properties described herein.
- B. The contractor shall submit, to the Engineer, a mix design based upon a trial batch or field experience, including the proportions and sources of all constituent materials, air entraining and (optionally) other admixtures, expressed as cubic yard batch weights. The mix shall contain a minimum of 50 pounds (23 kg) of cement and up to 250 pounds (114 kg) fly ash per cubic yard, with the remainder of the volumes composed of aggregates, water, and any approved admixtures. Measured compressive strength, air content and yield for the mix design trial batch (or for the field experience based mix design) shall be submitted.

2.4 COMPRESSIVE STRENGTH

- A. Flowable Fill shall be designed to achieve a 28 day compressive strength of 30 to 500 psi (0.2 to 3.4 mPa) when tested in accordance with ASTM C39. Excavatable mixes shall be designed to attain 28 day strengths in the range of 30 - 150 psi (0.2 to 1.0 mPa). Test specimens shall be made in accordance with ASTM D4832. Compressive strength tests shall be performed at frequencies of at least one test set per 150 yd³ (114m³) and at least one test set per day of placement.

2.5 CONSISTENCY

- A. Consistency of the fresh mixture shall be such that the mixture may be readily placed without segregation. High flowability material generally has a slump greater than 8 inches (20.3 cm). As an alternative to slump testing, desired consistency may be approximated by filling an open-ended 3 inch (76.2 mm) diameter cylinder, 6 inches (15.2 cm) high, with the mixture and cylinder immediately pulled straight up. The correct consistency of the mixture will produce an approximate 8 inch (20.3 cm) diameter circular type spread without segregation. Adjustments of the proportions of constituents may be made to achieve proper solid suspension and optimum flowability. However, strength requirements and proper yield shall be maintained for the actual batch weights.

PART 3: EXECUTION

3.1 CONSTRUCTION

- A. Comply with ACI 304 and ASTM C94 for Measuring, Mixing, Transporting, and Placing the Flowable Fill, and as herein specified.

3.2 LIMITATIONS OF PLACEMENT

- A. Do not place CLSM on frozen ground. Mix and place only when the air temperature is at least 35 degrees F (2°C) and rising. At the time of placement, Flowable Fill shall be at least 40 degrees F (4°C). Stop mixing and placement when the air temperature is 40 degrees F (4°C) and falling.
- B. Flowable backfill shall be placed by methods that preserve the quality of the material in terms of compressive strength, flow, homogeneity, plasticity and workability. The material shall be transported, placed, and/or consolidated so that it flows easily around, adjacent to and under structures. It shall have the flow, consistency, and workability such that the material is self-compacting.
- C. Protect freshly placed Flowable Fill from premature drying, excessive cold, or hot temperatures. The air in contact with the backfill surface shall be maintained at temperatures above freezing. Begin curing, immediately following placement before the backfill has dried. Continue with curing until the backfill has attained the 28 day strength requirement. This strength is to be determined prior to any load applications or construction activity, unless otherwise directed by an Engineer.

PART 4: MEASUREMENT AND PAYMENT

4.1 GENERAL

- A. Payment is made under: Flowable Fill – Per Cubic Yard (Cubic Meters).
- B. Payment shall include all labor, materials, equipment and incidentals necessary to provide, load, haul, place and consolidate the Flowable Fill.
- C. Measurement shall be based upon batch delivery tickets provided to the Engineer at the time of placement.

END OF SECTION

SECTION 02230 CONTROL OF WATER

PART 1: GENERAL

1.1 DESCRIPTION

The work covered by this section includes provisions to be considered by the Contractor to design, control, handle, and dispose of surface water and groundwater, and all other water that may be encountered, as required for performance of the work.

The Contractor will be responsible for the continuous control of water at all times during the course of earthwork and structure installation, and will provide adequate backup systems to accomplish control of water. The method of control, handling, and disposal of groundwater and surface water will be by whatever means are necessary and in conformance with this specification to obtain satisfactory working conditions and to maintain the progress of the work. All required drainage, pumping and disposal will be done without damage to adjacent property. The Contractor will modify the water control system at his own expense if, after installation and while in operation, fails to function or it causes or threatens to cause damage to adjacent property.

Control of water includes three aspects to facilitate earthwork and structure installation:

1. Diverting of river flow in two stages to allow construction of the project elements within the river channel. Stage one will allow construction of project elements on the west side of the river channel and stage two will allow construction of project elements on the east side of the river channel;
2. Dewatering the diverted river segment and fish trap area to allow construction of the channel, fish barrier and fish trap as shown in the Plans.
3. Controlling any and all groundwater, surface water and storm water.

Stream flow varies based on snowmelt and rainfall conditions. Average flows in the period of August through November are approximately 120 to 150 cfs. These flows and timings should be considered a rough estimate to provide some estimate of the flow diversion requirements at the project site. It is the Contractor's responsibility to determine flow diversion requirements.

PART 2: PRODUCTS

2.1 GENERAL

The Contractor will determine the materials required to meet these specifications.

Prior to start of work, the Contractor will furnish all labor, materials and equipment, and perform all operations required to design, furnish, install, test, pump, measure, and maintain the diversion and excavation dewatering equipment, including pumps, peizometers and pre-drainage well point and well systems, ditches, dikes, coffer dams; sandbags, sumps, power supply and distribution;

all as required to dewater the steam channel and excavations so that the work can be conducted under controlled conditions. The Contractor will demobilize all diversion and dewatering equipment and materials after completing the irrigation diversion retrofit and fish trap installation.

PART 3: EXECUTION

3.1 GENERAL

It is the intent of these specifications that water should be drained to the maximum reasonable extent prior to excavation and structure installation.

3.2 COORDINATION WITH LOWER SHIELDS RIVER CANAL COMPANY

The Lower Shields River Canal Company typically diverts water at the Chadbourne Diversion from mid-July to October 1. The canal company checks up the water level approximately 2-feet above the elevation of the existing concrete weir by installing boards over the top of the weir. Prior to October 1, all of the Contractor's dewatering operations must be coordinated with the canal company and will generally require maintaining about 2-feet of water relative to the existing concrete weir to allow the canal company to divert water to their canal.

3.3 FLOW CHARACTERISTICS

It is the responsibility of the Contractor to evaluate the seasonal flow characteristics of the Shields River and to size the Diversion and Dewatering measures to accommodate these seasonal flows. During rain events the flow rate in the Shields River can exceed the seasonal average. The Contractor will be responsible for calculating his own estimate of flow at any given time.

3.4 STREAM DIVERSION

The Contractor will temporarily divert flow in the Shields River to alternating sides of the channel as generally shown in the Plans to facilitate excavation and structure installation. The Contractor will take measures to minimize sediment transport during stream diversion.

The diversion will be installed in the general location shown in the Plans. The Contractor will size the diversion system to accommodate flow in the Shields River. The Contractor will be responsible for modifying the capacity of the diversion system to accommodate variable flows in the Shields River during the excavation and structure installation.

All man-made materials used to divert river flow will be removed from the project area and disposed of offsite upon completion of construction.

3.5 DEWATERING

The Contractor will excavate small, shallow sumps (i.e., 1-3 foot deep) within the dewatered river channel during construction of the fish barrier, channel improvements and the fish trap to

provide excavation dewatering. A small channel may be excavated to facilitate water flow from upstream areas. The Contractor will utilize one or more pumps to remove water from these areas. Water from the fish barrier, channel area and the fish trap area can be pumped to the adjacent ground to the west. Should pumped water flow from these areas directly to the river, the Contractor will obtain a construction dewatering permit and install measures to maintain the turbidity of the flowing water comparable to background, according to any permit requirements.

3.6 SUBMITTALS

Contractor will provide a Control of Water Plan submittal associated with Work covered by this Specification, to include:

1. Anticipated Schedule of Diversion and Dewatering Activities.
2. Shop Drawings depicting Control of Water practices to be implemented by the Contractor.
3. Hydraulic and other calculations showing the adequacy of the Control of Water Plan to meet criteria in Section 3.4 Stream Diversion.

The Control of Water Plan submittals will meet the requirements of the Permits that have been acquired for this project by the Owner. Minimum components of the Control of Water Plan submittals are specified in this Specification. Failure to comply with this requirement will result in withholding the Notice to Proceed (NTP).

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

There will be no measurement of activities associated with the Control of Water.

4.2 PAYMENT

Payment for the Control of Water specified in this section will be made based on the lump sum amount stated in the Bid.

SECTION 02240 DEMOLITION

PART 1: GENERAL

1.1 DESCRIPTION

This work consists of removing portions of the existing irrigation diversion weir and concrete/rock apron located downstream of the diversion weir. This work also includes any excavation necessary for preparation of the foundation installation of the Fish Barrier Structure.

PART 2: PRODUCTS

2.1 GENERAL

The Contractor will provide all materials and equipment in suitable and adequate quantities as required to accomplish the work shown, specified herein, and as required to complete the project.

PART 3: EXECUTION

3.1 GENERAL

The location of the elements to be demolished are indicated on the Plans and described herein. Portions of the existing concrete diversion weir and portions of the concrete and rock apron located downstream of the diversion weir will be removed. Carefully remove the materials without compromising the stability of the structure.

3.2 SEQUENCING

The structure is not to be demolished until flowing water through the structure is diverted and remains diverted and the Owner's Representative provides approval to remove portions of the structure.

3.3 DISPOSAL

Concrete materials comprising the diversion weir and apron will be removed from the project site. Contractor will be responsible for removal and disposal. Disposal will be in accordance with all applicable codes and regulations. Remove demolished materials from the site as work progresses.

Rock removed from the apron may be reused on the project if it meets the specifications for the various Rock types.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

No measurement will be made of activities associated with Demolition.

4.2 PAYMENT

Payment for the Demolition specified in this section will be made based on the lump sum amount stated in the Bid.

SECTION 02300 EARTHWORK

PART 1: GENERAL

1.1 DESCRIPTION

This work consists of the earthwork as specified and shown on the Plans, including excavation and backfill.

1.2 RESPONSIBILITY

It is the Contractor's responsibility to review the Plans, Specifications, and existing site conditions prior to bidding to ascertain the extent of the work requiring ground support systems. Elements designed, furnished and installed by Contractor for stability and safety during construction are not shown on the Plans.

1.3 SUBSURFACE AND SITE INFORMATION

With the exception of limited explorations described below, the Owner has not made estimates of the character of the subsurface materials. It will be the Bidder's sole responsibility to estimate the type and quantity of materials and the amount of surface and groundwater that will be encountered in the work, based on their selected methods of construction.

Field exploration data provided by the Owner includes a Stability Analysis Investigation completed in January 2011 by Allied Engineering Services, Inc.

PART 2: PRODUCTS

2.1 COMMON BACKFILL

Excavated borrow material free from roots and organic matter, topsoil, debris, rock fragments larger than 6 inches, and other deleterious materials. Material shall not have a liquid limit over 50 (e.g., no fat clay or elastic silt).

2.2 STRUCTURAL BACKFILL

A. GENERAL

- a. Furnish structural backfill material meeting the applicable aggregate quality requirements.

B. STRUCTURAL BACKFILL MATERIAL

- a. Furnish uncrushed material consisting of hard, durable stone, gravel or other similar materials mixed or blended with sand, stone dust, or other binding or filler

materials produced from approved sources, providing a uniform mixture meeting these specifications and compacted into a dense, and well-bonded material.

- a. Assure the material retained on the No. 4 sieve has a wear not exceeding 50 percent at 500 revolutions as determined by AASHTO T96.

C. GRADATION

- a. As determined by AASHTO Methods T11 and T27, furnish material for the grading specified in the contract documents including binder or filler, which may have been added at the plant or at the site, meeting the requirements of that grading in the Table of Gradations below:

TABLE OF GRADATIONS
PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVE

| | |
|---------------|------------|
| Passing | 1 ½" Minus |
| 4 Inch | 100 |
| 1 Inch | — |
| ¾ Inch | — |
| ½ Inch | — |
| No. 4 Sieve | 25 - 60 |
| No. 10 Sieve | — |
| No. 200 Sieve | 2 – 12 |

- b. Up to 5% "oversized" material is permitted provided that the "oversized" material passes the screen size immediately larger than the top size specified. The produced material between the maximum screen opening and the No.4 sieve will be reasonably well graded.
- c. Suitability of the aggregate is based on samples obtained during placement in the project within limits allowed in the table for the particular grading specified.
- d. The liquid limit for that portion of the fine aggregate passing a No. 40 sieve cannot exceed 25, nor the plasticity index exceed 6, as determined by AASHTO T89 and T90.

2.3 COMPACTION EQUIPMENT

Compaction equipment will be of suitable type and adequate to obtain the material in-place densities specified for the contract work acceptable to the Owner's Representative. Compaction equipment will be operated in strict accordance with the manufacturer's instructions and recommendations. Equipment will be maintained in such condition that it will deliver the manufacturer's rated compactive effort.

PART 3: EXECUTION

3.1 SITE PREPARATION

Site preparation includes the following.

1. Undertake the work associated with Erosion Control and Grubbing and Clearing as described in these Specifications.
2. Foundation preparation and water conditioning is critical. Maintain all exposed foundation surfaces in a moist condition (not saturated) at all times.
3. Proof-roll all foundation surfaces as needed or as directed by the Owner's Representative.
4. Excavate overly dry, overly wet, soft/yielding, or otherwise unsuitable subgrade as determined by the Owner's Representative, and replace with appropriate, compacted, fill for the location.
5. Grade areas to receive fill to the lines and grades shown prior to fill placement.

3.2 SHORING, SHEETING, AND BRACING OF EXCAVATIONS

Whenever necessary to prevent caving during excavation to protect adjacent structures, property, workmen, and the public, trenches and other excavations will be adequately sheeted and braced. Trench/excavation sheeting will be kept in place until the structure has been placed and backfilled. Shoring and sheeting will be removed as the backfilling is done, in a manner that will not damage the structure, or permit voids in the backfill. All sheeting, shoring, and bracing of trenches and other excavations will conform to the safety requirements of the Federal, State, or local public agency having jurisdiction over such matters. The most stringent of these requirements will apply.

All sheathing, shoring, and bracing of excavations will conform to the requirements of the Montana Rules of Industry, Labor, and Human Relations and OSHA. Sheathing, shoring, and bracing systems will be selected and placed in such a manner as to control the inflow of groundwater and infiltration of fines, to prevent bottom heave and to preserve the in-situ strength of soils in the bottom of the excavation. Sheathing, shoring, and bracing systems will be modified as necessary during the course of the work to suit all soil and groundwater conditions encountered.

3.3 GROSS EXCAVATION

All Gross Excavation for the project is included under this specification. Gross Excavation is the removal of earth, subsoil and stone material; it does not include the placement of backfill (which is described under Structural and Common Backfill). Gross Excavation will primarily consist of excavation at the concrete apron, the fish trap and the rock armor downstream of the concrete apron.

Excavate to the depths and widths, as shown in the Plans and as specified. Allow for sheathing, forms, working space, structural fill, and rock where required. Do not carry excavation deeper than the elevation shown. Excavation carried below the subgrade lines shown or established by the Owner's Representative will be replaced with approved compacted granular material. Cuts below grade will be corrected by similarly cutting adjoining areas and creating a smooth transition. The Contractor will bear all costs for correcting over-excavated areas.

3.4 SITE GRADING

Perform all earthwork to the elevations, lines, and grades as shown, specified, and/or established by the Owner's Representative, with proper allowance for rock and/or topsoil where specified or shown. Shape, trim, and finish slopes of channels to conform with the lines, grades, and cross-sections as shown or approved. Make slopes free of all exposed roots and stones exceeding 3-inch-diameter which are loose and liable to fall. Round tops of banks to circular curves, in general not less than a 6-foot radius. Rounded surfaces will be neatly and smoothly trimmed. Over-excavating and backfilling to the proper grade will not be acceptable. Finished site grading will be approved by the Owner's Representative.

3.5 TOLERANCES

Construct all earthwork and rock components of the project to the lines and grade shown on the Plans. Tolerance in the horizontal plane will be ± 1.0 ft. Final elevations will be ± 0.1 ft. of those shown on the Plans. Surface elevations of rock materials will be measured at the average surface height, which is defined as the elevation midway between the lowest and highest points of the exposed rock on the surface. No rock will deviate more than 0.5 ft. from the average surface elevation. This elevation tolerance may be increased for larger sized rock at the discretion of the Owner's Representative.

3.6 BACKFILL

A. COMMON BACKFILL

Fill to the lines and grades shown, or as approved by the Owner's Representative. Place fill in 12-inch lifts or less and compact each lift to 92 percent of relative density as determined by ASTM D698. Compact within the specified range of optimum water content as determined by AASHTO T 180. Make proper allowance for topsoil where required. Do not operate earth-moving equipment within 5 feet of walls of concrete structures for the purpose of depositing or compacting backfill material, except as approved. Compact backfill adjacent to concrete walls with hand-operated tampers or other approved equipment that will not damage the structure.

B. STRUCTURAL BACKFILL

Fill to the lines and grades shown, or as approved by the Owner's Representative. Place fill in 8-inch lifts or less and compact each lift to 95 percent of relative density as determined by ASTM D698. Compact within the specified range of optimum water content as determined by AASHTO T 180. Make proper allowance for topsoil where required. Do not operate earth-moving equipment within 5 feet of walls of concrete structures for the purpose of depositing or compacting backfill material, except as approved. Compact backfill adjacent to concrete walls with hand-operated tampers or other approved equipment that will not damage the structure.

3.7 FIELD QUALITY CONTROL

A. TESTING

1. The Owner's Representative will perform tests as required to verify that type of backfill used, placement of backfill, and compaction of backfill conforms to these Specifications and the Plans.
2. Notify the Owner's Representative 24 hours before compaction work begins and before significant change in compaction operations (major change in equipment or procedure used).
3. Notify the Owner's Representative immediately of equipment change due to breakdown or redeployment.

B. TESTING FREQUENCY

1. Frequency of testing is at discretion of the Owner's Representative.
2. Greater frequency of testing is normally performed at beginning of new work, new work crew, or new equipment.

C. TESTS

The Owner's Representative for testing compacted soil for conformance with specification requirements will generally use standards listed in the following table.

| Procedure | Standard Number |
|-------------------------------------------|----------------------------|
| Soil Classification | ASTM D 2487 ASTM D 2488 |
| Gradation Analysis | ASTM D 422 |
| Atterberg Limits | ASTM D 4318 |
| Laboratory Maximum Density | ASTM D 698 |
| Water (Moisture) Content | ASTM D 2216 |
| In-Place Moisture and Density: Nuclear | ASTM D 2922 ASTM D 3017 |
| Density In-place by Drive Cylinder Method | ASTM D 2937 |
| Relative Density of Cohesionless Soils | ASTM D 4253 ASTM D 4254 |
| In-Place Density: Sand Cone | ASTM D 1556 |
| Rapid Construction Control | ASTM D 5080 |

3.8 DISPOSAL OF EXCESS GROSS EXCAVATION MATERIAL

Excess Gross Excavation Material may result from the construction of this project. Excess material will be disposed of off-site or if approved by the Owner's Representative, placed in a location within the project site as directed by the Owner's Representative. Excess material will be graded to match the existing topography.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

No measurement will be made of activities associated with Gross Excavation.

No measurement will be made of activities associated with Structural or Common Backfill under this Specification.

No measurement will be made of activities associated with Disposal of Excess Gross Excavation Material under this specification.

4.2 PAYMENT

Payment for Earthwork which includes Gross Excavation and the Disposal of Excess Gross Excavation specified in this section will be made based on the lump sum amount stated in the Bid. The lump sum amount will constitute full compensation for all gross excavation and disposal of excess gross excavation, as well as materials, labor, equipment, and incidentals necessary to satisfy the Specifications and on the Plans.

No payment will be made for the Structural or Common Backfill under this Specification. Payment for Structural and Common Backfill will be made for work undertaken on one of the two specific portions of the project according to the respective Specifications. These portions include: 1) the Fish Trap Structure (Common Backfill); and 2) the Fish Barrier Structure (Structural Backfill).

Not in This Contract

SECTION 02400 FISH TRAP STRUCTURE

PART 1: GENERAL

1.1 DESCRIPTION

The Work covered by this section includes the furnishing of all labor, materials, equipment and incidentals for construction of the components comprising the Fish Trap Structure as shown on the Plans and described within these Specifications. The general area encompassing these features is referred to as the Fish Trap Structure on the Plans and in these Specifications. The major components that comprise the Fish Trap Structure listed from upstream to downstream generally include:

- Concrete Intake Box with Fish Screen
- Canal Gates: Two (2) Waterman C-10 18 inch canal gates
- Transport Pipes: Two (2) 18 inch CMP pipes
- Concrete Energy Dissipation Box
- Concrete Transport Channel
- Pipe Exiting the Transport Channel (Alternate Bid Item)
- Concrete V-Trap Structure with Fish Screens
- Canal Gate: Waterman C-10 6 inch canal gate (Alternate Bid Item)
- Covers for Energy Dissipation Box, Transport Channel and V-Trap

PART 2: PRODUCTS

2.1 BEDDING MATERIAL

Provide bedding material consisting of gravel with the following gradation.

TABLE OF GRADATIONS
PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVE

| Passing | 1" Minus |
|---------------|----------|
| 1 Inch | 100 |
| 3/4 Inch | — |
| 1/2 Inch | — |
| No. 4 Sieve | 8 |
| No. 10 Sieve | — |
| No. 200 Sieve | 0 - 1 |

2.2 COMMON BACKFILL

Common Backfill will meet the specifications in Section 02300 Earthwork for Common Backfill.

2.3 PRE-CAST CONCRETE STRUCTURES

It is the Contractors option to either cast in place or furnish precast concrete structures for the Energy Dissipation Box, Transport Channel and V-Trap. For precast concrete structures, the supplier will provide the structural design.

2.4 REINFORCING STEEL

Furnish Grade 60 bar reinforcement meeting the requirements of Section 03210 Reinforcing Steel.

2.5 STRUCTURAL CONCRETE

Furnish M-4000 Structural Concrete with a Total Air Content of six (6) percent meeting the requirements of Section 03310 Structural Concrete.

2.6 FISH SCREENS

At each fish screen location, embedded u-channels will be provided on the sides and the bottom of the concrete structures. A fish screen frame will slide into the u-channels. Fish screens will slide into the fish screen frame. The dimensions and layout specified in the Plans and specifications are approximate. The Contractor is responsible for furnishing and installing the fish screen components to ensure fit and function. Alternative layouts will be considered by the Owners' Representative and FWP during the submittal review process.

A. Fish Screen A (at Concrete Intake Box)

The screens will consist of a set of four identical screens with outside dimensions of 2 ft by 3 ft that are removable and installed in fish screen U-channel supports. Provide a means to lock the fish screens in the Concrete Intake Box.

A handle will be attached to each screen on one side of the 2 ft dimension for removal.

Screens will be made from ¼ inch slot opening wedge wire stainless steel. Each screen will be made from 1/8 inch thick wedge wire with a ¼ inch thick slot opening between wires. Screen openings and wedge wire will run parallel with the 2 ft length.

Furnish 1 inch Tall Type 304 stainless steel rectangular support rods, 3/16 inch thickness, at 3-inch spacing with the first rod 2 inches from the inside edge of frame. Support rods will run parallel with the 3 ft length.

Fish screen frames include four (4) sides and will be made from 1.5 inch tall Type 304 stainless steel, ¼ inch thickness.

Furnish 1 inch x 2.75 inch (minimum inside width for screen insert includes a 1/8 inch gap around framing for easy insert and removal) aluminum u-channel supports, 0.125 thickness, for fish screen channel slots. Weld two (2) inch long aluminum studs on outer edge of U-channels where embedded in concrete. Where embedded in concrete, a minimum of three (3) studs are required on each U-channel including two (2) on each end and one (1) centered.

Furnish 1/16 inch x 3/4 inch aluminum straps and 1/2 inch stainless steel self-tapping screws.

Screen brackets will be made from 2 inch wide by 3/16 inch thick aluminum. Support bracket frame will be inserted within the u-channels embedded in the concrete. Vertical sections of support bracket will be u-channel in shape to allow for insertion of fish screen. Fish screens will insert into the support brackets from the top.

B. Fish Screen B (at entrance of V-Trap structure)

The screen will consist of a set of four identical screens with outside dimensions of 2 ft x 5 ft that are removable and installed in fish screen U-channel supports.

A handle will be attached to each screen on one side of the 2 ft dimension.

Screens will be made from 1/4" stainless steel wire mesh for fish screens.

Furnish and install 1 3/4"x 1 3/4" aluminum tube, 0.125" wall thickness for all fish screen frames. Fish screen frames include four (4) sides and one (1) center support.

Furnish and install 1"x 2 3/4" aluminum U-channel supports, 0.125" thickness, for fish screen channel slots. Weld two (2) inch long aluminum studs on outer edge of U-channels where embedded in concrete. Where embedded in concrete, a minimum of three (3) studs are required on each U-channel including two (2) on each end and one (1) centered.

Furnish 1/16" x 3/4" aluminum straps and 1/2" stainless steel self-tapping screws.

Weld aluminum tubing and center supports with 1/8" welds at all framing joints.

Secure wire mesh to aluminum frame by attaching aluminum straps with self-tapping stainless steel screws. Space screws six (6) inches on center around entire frame and center support. Provide 1" clearance to wire mesh from outside edge of Aluminum tube, typical on all sides of frames.

Embed all U-channel supports 1" in concrete.

Screen brackets will be made from 2 inch wide by 3/16 inch thick aluminum. Support bracket frame will be inserted within the u-channels embedded in the concrete. Vertical

sections of support bracket will be u-channel in shape to allow for insertion of fish screen. Fish screens will insert into the support brackets from the top.

C. Fish Screen C (internal to the V-Trap structure)

The screen will consist of two sets: one set will consist of four identical screens with outside dimensions of 2 ft by 2 ft that are removable and installed in support brackets, and a second set will consist of four identical screens with outside dimensions of 2 ft x 3 ft that are removable and installed in support brackets.

A handle will be attached to each screen on one side of the 2 ft dimension.

Screens will be made from 1/4" stainless steel wire mesh for fish screens.

Furnish and install 1 3/4"x 1 3/4" aluminum tube, 0.125" wall thickness for all fish screen frames. Fish screen frames include four (4) sides and one (1) center support.

Furnish and install 1"x 2 3/4" aluminum U-channel supports, 0.125" thickness, for fish screen channel slots. Weld two (2) inch long aluminum studs on outer edge of U-channels where embedded in concrete. Where embedded in concrete, a minimum of three (3) studs are required on each U-channel including two (2) on each end and one (1) centered.

Furnish 1/16" x 3/4" aluminum straps and 1/2" stainless steel self-tapping screws.

Weld aluminum tubing and center supports with 1/8" welds at all framing joints.

Secure wire mesh to aluminum frame by attaching aluminum straps with self-tapping stainless steel screws. Space screws six (6) inches on center around entire frame and center support. Provide 1" clearance to wire mesh from outside edge of Aluminum tube, typical on all sides of frames.

Embed all U-channel supports 1" in concrete.

Screen brackets will be made from 2 inch wide by 3/16 inch thick aluminum. Support bracket frame will be inserted within the u-channels embedded in the concrete. Vertical sections of support bracket will be u-channel in shape to allow for insertion of fish screen. Fish screens will insert into the support brackets from the top.

2.7 CANAL GATES

Furnish Waterman C-10 18 inch canal gates or approved equal at the Concrete Intake Box in accordance with Section 02750 Canal Gates & Appurtenances and the Plans.

Furnish a Waterman C-10 6 inch canal gate or approved equal at the V-Trap Structure in accordance with Section 02750 Canal Gates & Appurtenances and the Plans.

2.8 TRANSPORT PIPES

Furnish 18 inch diameter galvanized corrugated metal pipe with a gauge of 14 in accordance with Section 02725 Drainage Culverts.

Furnish 90 degree elbows for galvanized corrugated metal pipe with a gauge of 14 in accordance with Section 02725 Drainage Culverts.

2.9 HOOK STEP LADDER

Deliver to the FWP Livingston office (1354 Highway 10 West, Livingston, MT 59047) a hook step ladder. FWP personnel will use the ladder to access the Energy Dissipation Box, the Transport Channel and the V-Trap. The make and model will be determined through the submittal review process.

2.10 PIPE EXITING THE TRANSPORT CHANNEL

Furnish PVC water main pipe and fittings meeting AWWA C900 requirements. Furnish an iron body gate valve with a cast iron valve box. Furnish a key for operating the gate valve and deliver the key to the FWP Livingston office.

2.11 COVERS FOR ENERGY DISSIPATION BOX, TRANSPORT CHANNEL AND V-TRAP

Furnish galvanized chain link fence covers with 9 gauge, 2-inch fabric mesh over the Energy Dissipation Box, the Transport Channel and the V-Trap Structure. Provide segmented panels light enough for field biologists to operate by hand. Hinge each panel on the east side of the Fish Trap Structure. Provide a hasp to allow for locking of each panel. Contractor may modify the material specifications and geometric layout of the covers through the submittal review process with approval from the Owners' Representative and FWP. Weight of each panel will be required in the submittals.

The cover for the V-Trap will be covered with ¼ inch polyethylene plastic mesh. The poly mesh will cover approximately 16 ft². Approximately 50 plastic ties will be needed to secure the plastic mesh to the cover.

2.12 TOPSOIL FOR SURFACE RESTORATION

Furnish Topsoil in accordance with Section 02700 Topsoil.

PART 3: EXECUTION

3.1 SUBGRADE

A. EXCAVATION

- a. Excavate to the specified lines and grades. Excavate without causing rutting, pumping or other disturbance to underlying materials.
- b. Correct subgrade disturbance before placing overlying fill. Disturbed soils may be replaced with imported material approved by the Owner's Representative and compacted to 95% of maximum laboratory dry density determined by AASHTO T99 or ASTM D698.
- c. Maintain the subgrade to drain at all times. Construct side ditches or gutters from cuts to embankments to prevent erosion damage to embankments.
- d. Excavate to minimize foundation soil and/or subgrade soil exposure to erosion, drying or infiltrating moisture. Perform excavation to provide drainage away from foundation/subgrade soils and minimize the potential for surface runoff to enter the foundation/subgrade soils.
- e. Dispose of debris and unused excavated materials off the project site in accordance with all applicable state and local regulations or onsite as approved by the Owner's Representative.

B. SUBGRADE PREPARATION AND COMPACTION

- a. Assure the finished surface does not deviate more than 0.1 foot at any point from the staked elevation; and that the sum of the deviations from true grade of any two points less than 30 feet apart does not exceed 0.1 foot.
- b. Compact the upper 8-inches of the subgrade to at least 95% of the laboratory maximum, determined by AASHTO T99 or ASTM D698. Proof roll the subgrade surface for observation by the Owner's Representative. Compact all soft, yielding or otherwise unstable areas to provide adequate support of construction equipment as determined by the Owner's Representative. Also compact the subgrade to meet the specified density requirements. Remove and replace any unstable or otherwise unsuitable subgrade.

3.2 BEDDING MATERIAL

Place bedding material in maximum lifts of 6 inches using hand operated or other compaction methods. Thoroughly compact each layer.

The bedding material surface when finished and tested with a 10-foot straight edge placed on the surface, will not have a surface deviation from the straight edge exceeding 1/2-inch. Additionally, the finished grade cannot deviate more than 0.1 feet at any point from the staked elevation, and further, the sum of the deviations from two points not more than 30 feet apart cannot exceed 0.1 feet.

3.3 COMMON BACKFILL

Common Backfill will be placed around the fish trap concrete structures and used to backfill the transport pipes. Placement of Common Backfill will be in accordance with Section 02300 Earthwork.

3.4 PRECAST CONCRETE STRUCTURES

Lift and install the precast structures (Energy Dissipation Box, Transport Channel and V-Trap) so that methods employed do not prevent the structures from being placed next to the adjacent structure without sliding them across the surface of the bedding material. In other words, utilize methods that allow temporarily suspended structures to be placed in the final locations shown on the Plans without moving them across and thus disturbing the bedding material. These methods will allow the structures to be installed tightly against each other while preserving the elevation and condition of the bedding material.

Connect the structures using mechanical fasteners before backfilling. Provide a watertight connection at each structure connection.

3.5 REINFORCING STEEL

Install Reinforcing Steel as specified in Section 03210 Reinforcing Steel.

3.6 STRUCTURAL CONCRETE

Install Structural Concrete as specified in Section 03310 Structural Concrete. Provide a smooth finish (like a garage floor) on the inside surface of the Concrete V-Trap Structure to prevent excessive wear on fish. Provide a smooth finish on the entrance to the Concrete V-Trap Structure (the south wall) to prevent excessive wear on fish. A broom finish on these inside surface and the entrance of the Concrete V-Trap Structure is not allowed.

3.7 FISH SCREENS

Weld aluminum tubing and center supports with 1/8" welds at all framing joints.

Secure wire mesh to aluminum frame by attaching aluminum straps with self-tapping stainless steel screws. Space screws six (6) inches on center around entire frame and center support. Provide 1 inch clearance to wire mesh from outside edge of Aluminum tube, typical on all sides of frames.

Embed all U-channel supports 1 inch in concrete.

Deliver a complete second set of Fish Screens to the FWP Livingston office (1354 Highway 10 West, Livingston, MT 59047). Delivery of a complete second set of Fish Screens is an Additive Alternate Bid Item.

3.8 CANAL GATES

Install Canal Gates as specified in Section 02750 Canal Gates & Appurtenances.

3.9 TRANSPORT PIPES

Install Transport Pipes as specified in Section 02725 Drainage Culverts. Place bedding material both six inches below and six inches above the pipe. On the side of the pipe, bedding material will extend one foot beyond the outside diameter of the pipe. Bed and surround the upstream most 5 feet of pipe with silt material. Place the silt material in 8-inch lifts or less and compact each lift to 95 percent of relative density as determined by ASTM D698. Compact within the specified range of optimum water content as determined by AASHTO T 180.

3.10 PIPE EXITING THE TRANSPORT CHANNEL

Provide a minimum of one foot of soil cover over the pipe.

3.11 COVERS FOR ENERGY DISSIPATION BOX, TRANSPORT CHANNEL AND V-TRAP

Secure the chain link covers to the Fish Trap Structure using a method approved by the supplier/manufacturer, the Owner's Representative and FWP.

The poly mesh will be fit to exactly the same dimensions as the V-Trap cover (see plan view of V-Trap). Poly mesh will be secured to the underside of the V-Trap cover with plastic ties (zip ties or equivalent). The ties will secure the plastic mesh to the metal tubing or metal wire and will be placed every 6 inches around the outer perimeter of the mesh cover. In addition, ties will be placed internally at a density of approximately 2 ties per square foot.

3.12 TOPSOIL

Place Imported Topsoil over common backfill in accordance with Section 02700 Topsoil.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

No measurement will be made for Fish Trap Structure.

No measurement will be made of Fish Trap Structure: Pipe Exiting the Transport Channel.

No measurement will be made of Fish Trap Structure: 6 inch Canal Gate.

No measurement will be made of Fish Trap Structure: Covers

No measurement will be made of activities associated with Topsoil under this Specification.

4.2 PAYMENT

Payment of Fish Trap Structure will be made based on the lump sum amount stated in the Bid. The lump sum price for Fish Trap Structure will constitute full compensation for all materials, labor, equipment, and incidentals necessary to furnish materials and for installation as specified in the specifications and on the Plans.

Payment of Fish Trap Structure: Pipe Exiting the Transport Channel will be made based on the lump sum amount stated in the Bid. The lump sum price for Fish Trap Structure: Pipe Exiting the Transport Channel will constitute full compensation for all materials, labor, equipment, and incidentals necessary to furnish materials and for installation as specified in the specifications and on the Plans.

Payment of Fish Trap Structure: 6 inch Canal Gate will be made based on the lump sum amount stated in the Bid. The lump sum price for Fish Trap Structure: 6 inch Canal Gate will constitute full compensation for all materials, labor, equipment, and incidentals necessary to furnish materials and for installation as specified in the specifications and on the Plans.

Payment of Fish Trap Structure: Covers will be made based on the lump sum amount stated in the Bid. The lump sum price for Fish Trap Structure: Covers will constitute full compensation for all materials, labor, equipment, and incidentals necessary to furnish materials and for installation as specified in the specifications and on the Plans.

No payment for Topsoil will be made for Topsoil under this Specification. Payment for Topsoil will be made under Section 02700 Topsoil.

SECTION 02500 FISH BARRIER STRUCTURE

PART 1: GENERAL

1.1 DESCRIPTION

The Work covered by this section includes the furnishing of all labor, materials, equipment and incidentals for construction of the components comprising the Fish Barrier Structure as shown on the Plans and described within these Specifications. The general area encompassing these features is referred to as the Fish Trap Structure on the Plans and in these Specifications. The components that comprise the Fish Barrier Structure listed generally include:

- Concrete Ogee Spillway
- Concrete Splash Pad
- Concrete Retaining Wall (on the left side of the splash pad)
- Irrigation Diversion Hardware

1.2 EXAMPLE CONCRETE OGEE INSTALLATION

A 5.5 foot tall by 37 feet long concrete ogee spillway was constructed in 2010 in Sweet Grass County south of Greycliff, Montana as part of a Montana Department of Fish, Wildlife & Parks fish barrier project on Lower Deer Creek. Photos of the project are provided at the end of this Section.

PART 2: PRODUCTS

2.1 FOUNDATION

A. GEOTEXTILE FABRIC

The fabric will be composed of a strong, rot-proof polymeric yarn or fiber oriented into a stable network that retains its relative structure during handling, placement, and long-term service. It will have complete resistance to deterioration from ambient temperatures, acid and alkaline conditions, and will be indestructible to microorganisms and insects. The material will be resistant to short-term (until placement) deterioration by ultraviolet light or protected until placement as recommended by the manufacturer such that no deterioration occurs. During shipment and storage, the rolls of fabric will be protected against deterioration from the sun, mud, dirt, dust, and other deleterious conditions at all times until their use.

The geotextile will have the following specific fabric properties as determined by the listed tests. All numerical values given below represent minimum average roll values; i.e., values measured for a sample should meet or exceed the specified values.

Use a Mirafi 1120N Nonwoven Geotextile or approved equal. Minimum mechanical properties are provided below.

| <u>Test Method</u> | <u>Minimum Average Roll Values</u> |
|--------------------------------------------|------------------------------------|
| Grab tensile strength (ASTM D-4632) | 300 lbs (MD); 300 lbs (CD) |
| Grab tensile elongation (ASTM D-4632) | 50% (MD); 50% (CD) |
| Trapezoidal tear (ASTM D-4533) | 115 lbs (MD); 115 lbs (CD) |
| CBR Puncture strength (ASTM D-6241) | 800 lbs |
| Apparent Opening Size (ASTM D-4751) | 100 U.S. Sieve (mm) |
| Permittivity (ASTM D-4491) | 0.8 sec ⁻¹ |
| Flow Rate (ASTM D-4491) | 65 gal/min/ft ² |
| UV Resistance (at 500 hours) (ASTM D-4355) | 70% strength retained |

B. BEDDING MATERIAL

Provide bedding material consisting of gravel with the following gradation.

TABLE OF GRADATIONS
PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVE

| Passing | 1" Minus |
|---------------|----------|
| 1 Inch | 100 |
| 3/4 Inch | — |
| 1/2 Inch | — |
| No. 4 Sieve | 8 |
| No. 10 Sieve | — |
| No. 200 Sieve | 0 - 1 |

C. STRUCTURAL BACKFILL

Structural Backfill will meet the specifications in Section 02300 Earthwork for Structural Backfill.

D. FLOWABLE FILL

Flowable Fill will meet the specifications in Section 02225 Flowable Fill.

2.2 STRUCTURAL CONCRETE

A. REINFORCING STEEL

Furnish Grade 60 bar reinforcement meeting the requirements of Section 03210 Reinforcing Steel.

B. STRUCTURAL CONCRETE

Furnish M-4000 Structural Concrete with a Total Air Content of six (6) percent meeting the requirements of Section 03310 Structural Concrete.

Furnish pre-formed expansion joint material meeting the requirements of AASHTO M213.

2.3 IRRIGATION DIVERSION HARDWARE

Furnish square structural steel tubing measuring 4.5 inch by 4.5 inch with a thickness of 0.25 inches. This will provide a square inside opening of 4 inches x 4 inches for the irrigation company to insert a 3.5 inch by 3.5 inch (nominal) wood post. Furnish steel tubing to the dimensions shown on the Plans. Provide fasteners to securely attach the tubing to the existing concrete weir.

Furnish new irrigation diversion boards and posts. Coordinate with the Lower Shields River Canal Company to establish the number of boards, the materials specification and the geometric layout required. Ensure that the new irrigation diversion boards and posts fit with both the new steel tubing layout and the existing board slots on the abutments. The existing diversion utilizes roughly 18.5 feet long x 9.5 inch wide x 2 inch thick boards and 3.75 feet tall, 4 inch diameter posts. The Lower Shields River Canal Company typically stacks 3 boards high to allow for a headwater of roughly 2 feet relative to the top of the existing concrete weir.

Changes to the irrigation diversion hardware material specifications will be considered during the submittal review process and will be contingent on approval by the Owner's Representative and/or the Lower Shields River Canal Company.

2.4 PORTAGE SIGNS

Furnish three portage signs as follows:

- Sign size is 3-ft tall by 6-ft wide
- Post length is 12-ft (with 3-ft in the ground)
- Red text on a white background
- Secure sign to the post using two treated 4-in x 4-in posts
- Two signs will read "PORTAGE AHEAD, RIVER RIGHT"
- One sign will read "PORTAGE HERE"

PART 3: EXECUTION

3.1 FOUNDATION

A. EXCAVATION

- a. Excavate to the specified lines and grades. Excavate without causing rutting, pumping or other disturbance to underlying materials.
- b. Correct subgrade disturbance before placing overlying fill. Disturbed soils may be replaced with imported material approved by the Owner's Representative and compacted to 95% of maximum laboratory dry density determined by AASHTO T99 or ASTM D698.

- c. Maintain the subgrade to drain at all times. Construct side ditches or gutters from cuts to embankments to prevent erosion damage to embankments.
- d. Excavate to minimize foundation soil and/or subgrade soil exposure to erosion, drying or infiltrating moisture. Perform excavation to provide drainage away from foundation/subgrade soils and minimize the potential for surface runoff to enter the foundation/subgrade soils.
- e. Dispose of debris and unused excavated materials off the project site in accordance with all applicable state and local regulations or onsite as approved by the Owner's Representative.

B. SUBGRADE PREPARATION AND COMPACTION

- a. Assure the finished surface does not deviate not more than 0.1 foot at any point from the staked elevation; and that the sum of the deviations from true grade of any two points less than 30 feet apart does not exceed 0.1 foot.
- b. Compact the upper 8-inches of the subgrade to at least 95% of the laboratory maximum, determined by AASHTO T99 or ASTM D698. Proof roll the subgrade surface for observation by the Owner's Representative. Compact all soft, yielding or otherwise unstable areas to provide adequate support of construction equipment as determined by the Owner's Representative. Also compact the subgrade to meet the specified density requirements. Remove and replace any unstable or otherwise unsuitable subgrade.

C. GEOTEXTILE FABRIC

The geotextile will be placed as shown in the Plans, and field verified by the Owner's Representative. Overlaps and splices of the material will be in accordance with recommended manufacturers materials specifications, and field verified by the Owner's Representative.

Any protrusions through the geotextile (i.e. the by-pass culvert) will be tightly sealed by means of overlap or mechanical splice, as directed and verified by the Owner's Representative.

D. BEDDING MATERIAL

Place bedding material in maximum lifts of 6 inches using hand operated or other compaction methods. Thoroughly compact each layer.

The bedding material surface when finished and tested with a 10-foot straight edge placed on the surface, will not have a surface deviation from the straight edge exceeding 1/2-inch. Additionally, the finished grade cannot deviate more than 0.1 feet at any point from the staked elevation, and further, the sum of the deviations from two points not more than 30 feet apart cannot exceed 0.1 feet.

E. STRUCTURAL BACKFILL MATERIAL

Place Structural Backfill with approval of the Owner's Representative to build up the area under the Splash Pad to subgrade elevation. Install Structural Backfill in accordance with Section 02300 Earthwork. It is not known whether or how much Structural Backfill will be required in the preparation of the Fish Barrier Structure foundation. Structural Backfill will not be paid separately but is included in the payment for Fish Barrier Structure: Foundation.

F. FLOWABLE FILL

Place Flowable Fill with approval of the Owner's Representative to fill cavities below the subgrade of the Fish Barrier Structure. Place Flowable Fill as specified in Section 02225 Flowable Fill. It is not known whether or how much Flowable Fill will be required in the preparation of the Fish Barrier Structure foundation. Flowable Fill will not be paid separately but is included in the payment for Fish Barrier Structure: Foundation.

3.2 STRUCTURAL CONCRETE

A. REINFORCING STEEL

Install Reinforcing Steel as specified in Section 03210 Reinforcing Steel.

B. STRUCTURAL CONCRETE

Install Structural Concrete as specified in Section 03310 Structural Concrete. Provide a smooth finish (like a garage floor) on the top surface of the Concrete Ogee Spillway and the Concrete Splash Pad to prevent excessive wear on fish. A broom finish on these surfaces is not allowed.

Sequence the concrete placement for the Ogee Spillway and the Splash Pad so that no more than four concrete pours are necessary. The four concrete pours will be as follows:

1. Ogee Spillway on the west side;
2. Splash Pad on the west side;
3. Ogee Spillway on the east side; and
4. Splash pad on the east side.

It may be beneficial to pour a concrete footing to provide a level surface for anchoring the Ogee Spillway forms. If this method is used to anchor the forms, the contractor will be responsible for the design of the footing/anchoring system and responsible for ensuring the system does not interfere with any project elements.

Assure all expansion/isolation joint materials extend the full depth of the concrete. Form cold joints at unions of consecutive pours as shown on the plans or directed by the Engineer. Assure the cold joint is vertical, the full depth of the concrete, and tooled to a one-quarter inch (1/4-inch) radius.

Assure all concrete surfaces present clean, uniform surfaces and lines free of irregularities and distortions. Plane surfaces and vertical tangent lines are tested with a 10-foot straightedge and cannot deviate more than one-quarter inch (1/4-inch) from the straightedge. The geometric shape and elevation of the concrete surfaces will not deviate from the specified geometric dimensions and elevation by more than one-quarter inch (1/4-inch).

3.3 IRRIGATION DIVERSION HARDWARE

Secure the irrigation diversion hardware to the existing concrete weir and within the concrete ogee spillway forms so no movement of the hardware occurs during placement of the concrete ogee spillway.

Prior to the 2013 irrigation season and if requested by the Lower Shields River Canal Company, complete a test installation of the new irrigation diversion boards and posts. Make any adjustments requested by the canal company. Remove the posts and boards immediately following the test installation.

Changes to the irrigation diversion hardware geometric layout will be considered during the submittal review process and will be contingent on approval by the Owner's Representative and/or the Lower Shields River Canal Company.

Both the Owner's Representative and the Lower Shields River Canal Company will be required to review and approve the submittals for the Irrigation Diversion Hardware.

3.4 PORTAGE SIGNS

The location of the signs shown in the plans is approximate. Coordinate installation location with FWP. Provide a 3-ft bury depth.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

No measurement will be made of Fish Barrier Structure: Foundation.

No measurement will be made of Fish Barrier Structure: Structural Concrete.

No measurement will be made of Fish Barrier Structure: Irrigation Diversion Hardware.

Portage Signs will be measured by the individual unit.

4.2 PAYMENT

Payment for Fish Barrier Structure: Foundation will be made based on the lump sum amount stated in the Bid. The lump sum price for Fish Barrier Structure: Foundation will constitute full

compensation for all materials, labor, equipment, and incidentals necessary to furnish materials and for installation as specified in the specifications and on the Plans.

Payment for Fish Barrier Structure: Structural Concrete will be made based on the lump sum amount stated in the Bid. The lump sum price for Fish Barrier Structure: Structural Concrete will constitute full compensation for all materials, labor, equipment, and incidentals necessary to furnish materials and for installation as specified in the specifications and on the Plans.

Payment for Fish Barrier Structure: Irrigation Diversion Hardware will be made based on the lump sum amount stated in the Bid. The lump sum price for Fish Barrier Structure: Irrigation Diversion Hardware will constitute full compensation for all materials, labor, equipment, and incidentals necessary to furnish materials and for installation as specified in the specifications and on the Plans.

Payment for Portage Signs will be made at the unit price per Portage Sign as stated in the Bid. The unit price for each Portage Sign will constitute full compensation for all coordination, materials, labor, equipment, and incidentals necessary to furnish materials and for installation as specified in the specifications and on the Plans.



SECTION 02600 CHANNEL CONSTRUCTION

PART 1: GENERAL

1.1 DESCRIPTION

The Work covered by this section includes the furnishing of all labor, materials, equipment and incidentals for construction of the Rock Channel Armor downstream of the Fish Barrier Structure, ~~the Step Pool Channel leading to the Fish Trap Structure, the Transport Channel Overflow Swale and the Streambank Fabric Encapsulated Soil to tie in the downstream end of the Step Pool Channel to the existing low riverbank.~~

PART 2: PRODUCTS

2.1 ROCK CHANNEL ARMOR DOWNSTREAM OF FISH BARRIER STRUCTURE

A. ROCK TYPE 1

Rock Type 1 will be used downstream of the Fish Barrier Structure to provide scour protection for the structure. Rock Type 1 is rock riprap angular in shape. Salvaged stone materials from the existing project area may be used if determined to be acceptable by the Owner's Representative. Riprap will be hard and durable stone with less than 35 percent wear when tested for resistance to abrasion in conformance to ASTM C535. Bulk density will not be less than 160 pounds per dry cubic foot. The least dimension of any one piece will not be less than 1/3 the greatest dimension. Each load of Riprap will be reasonably well graded from the smallest to the maximum size specified. Stone size gradation for Riprap will conform to the following gradation:

| Size* | Percent Smaller by Weight |
|---------|---------------------------|
| 48-inch | 100 |
| 36-inch | 50 |
| 24-inch | 15 |

Rock will be measured along the B-axis, which is the second largest dimension of the rock. That is, use the dimensions of length, height, and width to describe the rock; with length being the A-axis and the longest dimension of the rock, then the B-axis is the longer of the height and width dimensions.

2.2 ROCK FOR FISH TRAP STEP POOL CHANNEL AND STREAMBANK STABILIZATION

Not in This Contract

Unless otherwise specified, all Rock larger than 1/2 inch in diameter will be naturally rounded in shape and will have a naturally smooth surface, such as rock that has as its source a former stream, river or glacial deposit. Salvaged natural rock materials, either from the river channel or the spillway excavation area from within the project area, may be used. Rock will be hard and

durable stone with less than 35 percent wear when tested for resistance to abrasion in conformance to ASTM C535. Bulk density will not be less than 160 pounds per dry cubic foot. The least dimension of any one piece will not be less than 1/3 the greatest dimension. Shot quarry stone, crushed rock, broken concrete or recycled construction products will not be allowed. Each load of Rock will be reasonably well graded from the smallest to the maximum size specified.

Rock will be measured along the B-axis, which is the second largest dimension of the rock. That is, use the dimensions of length, height, and width to describe the rock; with length being the A-axis and the longest dimension of the rock, then the B-axis is the longer of the height and width dimensions.

A. ROCK TYPE 2

Vane rock will be used to construct three rock step features as shown on the plan set. Vane rock shall be sub-angular in shape and such that individual particles can be placed side by side in a manner that minimizes gaps between the rocks. For this project sub-angular rock is defined as blocky in nature but lacking sharp points and edges typical of quarried rock. Sub-angular rock is also distinguished from smooth river rounded rock. Rock will be hard and durable stone with less than 35 percent wear when tested for resistance to abrasion in conformance to ASTM C535. Bulk density will not be less than 160 pounds per dry cubic foot. The least dimension of any one piece will not be less than 1/3 the greatest dimension. Shot quarry stone, crushed rock, broken concrete or recycled construction products will not be allowed. Each load of Rock will be reasonably well graded from the smallest to the maximum size specified.

Rock Type 2 will conform to the following gradation:

| Size | Percent by Weight |
|-----------------|-------------------|
| > 18 to 24-inch | 100 |

B. ROCK TYPE 3

Rock Type 3 (engineered streambed material {ESM}) will be used as fill for the stream bed and overbank channel slopes. Rock Rock Type 3 will be naturally rounded in shape and will have a naturally smooth surface, such as rock that has as its source a former stream, river or glacial deposit.

Rock Type 3 will conform to the following gradation:

| Size | Percent Smaller by Weight |
|---------|---------------------------|
| 12-inch | 100 |
| 9-inch | 75-85 |
| 7-inch | 35-50 |
| 3-inch | 15-20 |

C. ROCK TYPE 4

Rock Type 4 will be used to fill the interstitial spaces in the placed Rock Types 2 & 3. Rock Type 4 will be 1 inch minus sandy gravel from an alluvial or glacial source. Salvaged natural materials from sediment deposits, either from the river channel or the spillway excavation area from within the project area, may be used.

Rock Type 4 will conform to the following gradation:

| Size | Percent Smaller by Weight |
|--------|---------------------------|
| 1-inch | 100 |

2.3 ROCK FOR TRANSPORT CHANNEL OVERFLOW SWALE **Not in This Contract**

Rock Type 5 will be used to line the Transport Channel overflow swale. Rock Type 5 will be oversize cobbles ranging in size from 8-inch to 12-inch.

2.4 ROCK SUBMITTALS AND MATERIALS HANDLING AND STORAGE

A. SUBMITTALS

The Contractor will submit the following information to the Owner's Representative for approval:

1. Name, address, and phone number of all stone suppliers, including location of quarry or pit.
2. Certified analysis of all materials to be used that show compliance with these specifications (including gradation analysis).
3. Samples or arrange for a visit to the quarry or pit by the Owner's Representative for approval for materials obtained off-site prior to delivery of materials.

B. MATERIAL APPROVAL

All tests necessary for the Contractor to locate an approved source of Stone will be made by the Contractor. Certification that the material conforms to the Specification requirements along with copies of the test results from an approved commercial testing laboratory will be submitted to the Owner's Representative for approval at least 30 days before the material is required for use. Sampling of the material source will be done by the Contractor under the review by the Owner's Representative in accordance with ASTM D75. Tentative approval of the material source will be based on an inspection of the source by the Owner's Representative and the certified test results submitted by the Contractor to the Owner's Representative. No imported materials will be delivered to the site until the proposed source and tests on the materials have been tentatively approved in writing by the Owner's Representative.

Gradation tests will be made at the place of production by the Contractor prior to shipment. Samples of the finished product for gradation testing will be taken from each 100 tons installed or more often as requested by the Owner's Representative if variation in gradation is occurring

or if the material appears to depart from the Specifications. Test results will be forwarded to the Owner's Representative within 48 hours after sampling. If tests conducted by the Contractor or the Owner's Representative indicate that the material does not meet Specification requirements, material placement will be terminated until corrective measures are taken. Material that does not conform to the Specification requirements and is placed in the work will be removed and replaced at the Contractor's expense. Sampling and testing performed by the Contractor will be done at no additional cost to the Owner.

C. MATERIALS HANDLING AND STORAGE

Store materials on site in a manner that ensures that Rock is not mixed with other materials. Rock mixed with other materials will be replaced at the Contractor's expense. Transport and stage Rock to minimize sorting of the graded mixture. The Owner's Representative will inspect and approve all materials prior to installation.

2.5 TOPSOIL FOR STREAMBANK FABRIC ENCAPSULATED SOIL & STEP POOL CHANNEL AREA **Not in This Contract**

Imported Topsoil will meet the specifications in Topsoil Section 02700.

2.6 EROSION CONTROL FABRIC FOR STREAMBANK FABRIC ENCAPSULATED SOIL **Not in This Contract**

Coir fabric is a biodegradable erosion control fabric made from the fibers of coconut husks. Woven coir fabric is used to protect the reconstructed streambanks as shown in the Plans.

A. COIR FABRIC MATERIAL PROPERTY REQUIREMENTS

The woven coir fabric material for streambank construction will consist of 100% coconut fiber in continuously woven mat. The material will conform to the following values:

| | | |
|------------------------|------------|------------------------|
| Thickness | ASTM D1777 | 0.30 in. (min) |
| Tensile Strength (dry) | ASTM D4595 | 100 x 70 lb./in. (min) |
| Mass Per Unit Area | ASTM D3776 | 20 oz./sy. (min) |
| Open Area | Measured | 50% (max) |
| Roll Width | Measured | 6.56 ft (min) |

B. PREAPPROVED PRODUCTS

Woven coir fabric will be DeKoWe 700, Nedra KoirMat 700, Rolanka BioDMat 70 or approved equal. Do not order, deliver, or install other products without the written approval of the Owner's Representative.

C. SUBMITTALS

Contractor will provide the following submittals.

1. Name, address, and phone number of supplier(s) of all coir fabrics used on the project.
2. Technical Specification of the coir fabrics with associated testing standards with 8 by 10 inch samples in plastic bags.
3. Documentation of equivalency to products specified.
4. Manufacturer's shipping, storing, and placement recommendations.

2.7 WOODEN STAKES FOR STREAMBANK FABRIC ENCAPSULATED SOIL

Not in This Contract

Fabric stakes will be wooden stakes 12 inches long and 1 inch by 0.75 inches in diameter, or other dimensions as approved by the Owner's Representative. Fabric stakes will not be treated with preservative. Other types of stakes will be subject to the approval of the Owner's Representative. Metal pins or staples are not acceptable.

Preapproved stakes are Wooden Pegs from Rolanka International (www.rolanka.com) as long as they meet the dimension and length requirements in these specifications.

2.8 GEOTEXTILE FILTER FABRIC FOR SUBGRADE FLOW SEPARATOR IN STEP POOL CHANNEL

Not in This Contract

The Geotextile Filter Fabric will be placed at three locations along the Step Pool Channel within the rock mix of the Step Pool Channel to serve as Subgrade Flow Separators, as indicated in the Plans. The intention is to provide a medium that will collect fine sediment and organic detritus and will eventually clog, forcing subsurface and interstitial flow to the surface as surface flow in the channel.

Geotextile Filter Fabric will be composed of a strong, rot-proof polymeric yarn or fiber oriented into a stable network that retains its relative structure during handling, placement, and long-term service. It will have complete resistance to deterioration from ambient temperatures, acid and alkaline conditions, and will be indestructible to microorganisms and insects. The material will be resistant to short-term (until placement) deterioration by ultraviolet light or protected until placement as recommended by the manufacturer such that no deterioration occurs. During shipment and storage, the rolls of fabric will be protected against deterioration from the sun, mud, dirt, dust, and other deleterious conditions at all times until their use.

The Geotextile Filter Fabric will have the following specific fabric properties as determined by the listed tests. All numerical values given below represent minimum average roll values (i.e., values measured for a sample should meet or exceed the specified values).

| <u>Test Method</u> | <u>Minimum Average Roll Values</u> |
|---------------------------------------|------------------------------------|
| Grab tensile strength (ASTM D-4632) | 205 lbs (MD); 205 lbs (CD) |
| Grab tensile elongation (ASTM D-4632) | 50% (MD); 50% (CD) |
| Trapezoidal tear (ASTM D-4533) | 80 lbs (MD); 80 lbs (CD) |
| CBR Puncture strength (ASTM D-6241) | 500 lbs |
| Apparent Opening Size (ASTM D-4751) | 80 |

| | |
|--------------------------------------------|----------------------------|
| Permittivity (ASTM D-4491) | 1.1 sec ⁻¹ |
| Flow Rate (ASTM D-4491) | 95 gal/min/ft ² |
| UV Resistance (at 500 hours) (ASTM D-4355) | 70% |

Geotextile Filter Fabric will be Mirafi 180N Nonwoven Geotextile or approved equal.

PART 3: EXECUTION

3.1 ROCK DOWNSTREAM OF BARRIER

Rock will be placed in the streambed immediately downstream from the fish barrier structure as shown in the plans to prevent scour of the streambed. Rock will be placed to the approximate grade and in the approximate location as shown in the Plans.

3.2 STEP POOL CHANNEL CONSTRUCTION AND STREAMBANK RECONSTRUCTION Not in This Contract

Construct the Step Pool Channel and reconfigure the geometry of the streambank adjacent to the Step Pool Channel in the area shown on the Plans to match the existing streambank and to tie into the riverbed.

Sub-excavate the step pool channel corridor and smooth and bucket compact the sub-grade prior to placing vane rock. Sub-excavation shall be completed to a depth approximately equal to the vane thickness. Construct vanes using Rock Type 2. Place footer rock in a manner that minimizes gaps between the rocks. Following footer placement, install the geotextile subgrade flow separator materials as described in Section 3.3. Backfill footer rock on its upstream face with Rock Type 3 to an elevation equal to the top of the footer rock. Wash Rock Type 4 materials into the Type 3 matrix until the layer will not accept any more material. Washing of fines may be accomplished with the use of a pump or by using an excavator bucket.

Place Rock Type 2 materials on top and slightly upstream of the footer rock to complete the finished grade of each vane. The approximate center of each vane top-rock shall be placed approximately 1 foot upstream of the corresponding footer rock. The vane throat (located near the center of the vane) shall be approximately 0.5 feet lower in elevation than the lateral extents of each vane. Following completion of the vane backfill as described for the footer rock but terminate fill approximately ½ way to the top of the vane.

Upon completion of a pair of vanes fill the entire bounded channel area with Rock Type 3 to a depth of 1.5 feet. Rock Type 4 shall then be washed into the matrix. Care should be taken to ensure that the channel bed geometry is completed as shown on the Plans. More specifically, that the maximum pool depth is achieved on the downstream face of each vane.

From the lateral extents of the vanes and channel fill, Rock Type 3 shall be placed at a maximum 2:1 slope to match the existing undisturbed ground. This overbank protection shall be a minimum of 1.5 feet in thickness. Rock Type 4 shall be washed or mechanically brushed into the overbank protection matrix.

Following completion of the overbank areas, large materials of the Rock Type 2 material (>1.5 ft) shall be placed within the channel as shown on the plan set at a rate of 6 to 8 boulders in each pool.

During excavation of the step pool channel, all willows within the disturbance boundary shall be salvaged, stored and transplanted to the finished overbank surface to the south of the step pool channel and the fish trap. Willow salvage and transplanting will not be paid separately but will be made incidental to the Channel Construction: Rock Type 2, 3, 4 and 5 bid items.

3.3 FABRIC-ENCAPSULATED SOIL USING EROSION CONTROL FABRIC TYPE 1

Not in This Contract

Fabric-encapsulated soil (FES) is a ground surface treatment in which soil is overlain by and contained by the Erosion Control Fabric. FES lifts are “pillows” of fabric-encapsulated soil used to form the upper (vegetated) portion of stream banks. FES lifts include a high-tensile strength woven coir fabric covering that provides tensile strength and resistance to surface erosion; an inner layer of straw that provides a barrier, or filter, to prevent the loss of fine soil material from within the lift and as a surface mulch; and seed.

The Erosion Control Fabric will be installed with a minimum 18-inch embedment length (under the lift) as shown on the Plans. The face of the FES lifts will be installed to butt against the inner edge of the rock used to construct the channel. The configuration of the lift face will be variable to account for differing rock size and shape. The surface of the FES will be generally uniform and gradually varying to follow the dimensions shown on the Plans. Where installation of the FES results in a fully exposed lift (that is, not butted up against the inner edge of rock), graded rock (using Rock Type 3) will be placed along the face of the FES up to at least 2/3 up the face of the FES lift.

The Erosion Control Fabric in the FES lifts will be installed as a more or less continuous roll parallel to the channel banks. The Plans depict dimensions for key trench staking based on use of fabric in 6.56 ft roll widths. All joints between fabric rolls will be a minimum of 2 feet. Wooden stakes in key trenches will be installed no more than 3 feet apart. Fabric folds, if they occur, will be formed by folding fabric with the fold in the downstream direction. Folds will be staked with wooden stakes no more than 3 feet apart or as needed to secure the fold. Anchoring trenches will be as shown on the Plans. For FES, willow cuttings will be installed as shown in the Plans. The cuttings shall be installed after the rock comprising the channel has been completed and before placement of the FES Erosion Control Fabric. Live cuttings will be installed at an average density of one per lineal foot of riverbank with FES treatment.

The Contractor will handle the fabric in a manner that does not damage the fabric or deposit soil in the stream channel. Erosion control fabric will be placed by rolling the fabric lengthwise, parallel to the channel. The erosion control fabrics will be even, smooth, and taut, such that the fabric is in direct contact with the underlying subbase in all areas, as shown on the Plans, and to the satisfaction of the Owner’s Representative. Mechanical tightening may be required to remove slack and provide containment of underlying soils as approved by the Owner’s Representative.

During installation of the Erosion Control Fabric for FES, care will be exercised so as to draw the fabric tight as it is staked in place. Typically, several pry bars are used to gradually tighten the fabric as it is finally pulled into position and staked.

Install Wooden Stakes along the key trenches at three (3) foot spacing or as approved by the Owner's Representative. Do not cut woven coir fabric to install stakes: thread stakes between fabric strands. Stakes may be angled up to 45 degrees with respect to vertical if underlying stone materials prevent vertical insertion. Broken, split, or damaged stakes will be removed and replaced at the Contractor's expense. After Wooden Stake installation is complete, backfill staking trenches as shown on the Plans.

3.4 GEOTEXTILE FILTER FABRIC FOR SUBGRADE FLOW SEPARATOR IN STEP POOL CHANNEL **Not in This Contract**

Place Geotextile Filter Fabric as shown in the Plans. In general, place the fabric in an L-shape and straight line between the Rock comprising the constructed step pool channel, from one bank to the other, and including the banks.

Where possible, place a single continuous piece of fabric across the channel. Where two pieces of fabric material are used, overlaps of the fabric will be a minimum of 3 feet or as needed to ensure a continuous treatment of fabric across the riverbed. Care will be taken so as not to puncture the fabric during placement of the adjacent rock.

The fabric material will be placed so that the highest extent of the fabric is about 0.5 foot from the surface of the channel as shown in the Plans. Installing the fabric so that it extends higher (closer to the finished riverbed surface) and trimming it to the appropriate height is a recommended method.

Geotextile Filter Fabric will not be paid for separately but will be made incidental to the Channel Construction: Rock Type 2, 3, and 4 bid items.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Measurement of Channel Construction: Rock Types 1 through 5 will be by the ton, according to weight tickets provided by the Contractor to the Owner's Representative.

Measurement of Channel Construction: Streambank FES will be by the lineal foot of correctly installed Fabric Encapsulated Soil.

4.2 PAYMENT

Payment for Channel Construction: Rock Types 1 through 5 will be made at the unit price per ton. The unit price per ton for Rock will constitute full compensation for all materials, labor,

equipment, and incidentals necessary to furnish materials and for installation as specified in the specifications and on the Plans.

Payment for Channel Construction: Streambank FES will be by the unit price per lineal foot of completed and approved Streambank Fabric Encapsulated Soil as stated in the bid. The unit price per lineal foot will constitute full compensation for all rock, topsoil, erosion control fabric, installation of live cuttings, seeding, wooden stakes, labor, equipment, and incidentals necessary to furnish materials and for installation as specified in the specifications and on the Plans.

Not in This Contract

Not in This Contract

SECTION 02700 TOPSOIL

PART 1: GENERAL

1.1 DESCRIPTION

The Work covered by this section includes the furnishing of all labor, materials, equipment and incidentals for importing, storing and handling Topsoil for placement in the areas as shown on the Plans and described within these Specifications. Topsoil is an alternate bid item.

PART 2: PRODUCTS

2.1 TOPSOIL MATERIAL PROPERTIES

Topsoil used for this project will be from imported sources outside of the project area.

Imported Topsoil will comply with the following requirements, or as approved by the Owner's Representative:

- A. Contain no less than 2 percent nor more than 13 percent organic matter, as determined by the test for organic matter in accordance with ASTM D2974.
- B. Contain no less than 12 percent or more than 40 percent clay, as determined in accordance with ASTM D422.
- C. Sand content will not exceed 55 percent, as determined in accordance with ASTM D422.
- D. The pH will not be lower than 5.0 or higher than 8.0. The pH will be determined with an acceptable pH meter on that portion of the sample passing the No. 10 sieve, in accordance with the "Suggested Methods of Tests for Hydrogen Ion Concentration (pH) of Soils," included in the ASTM Procedures for Testing Soils issued December 1964.
- E. Topsoil will meet the following mechanical criteria: 100 percent will pass the 1-inch screen; 97-100 percent will pass the 1.5-inch screen; and 40-60 percent will pass the No. 100 mesh sieve.
- F. Topsoil will be free of clods, gravel, and other inert material. It will be free of quackgrass, cattail, buckthorn, thistle, garlic mustard, reed canary grass and other noxious vegetation and seed. Should such regenerative material be present in the soil, the Contractor will remove, at his expense and in a manner satisfactory to the Owner's Representative, all such growth, both surface and root, which may appear in the imported topsoil within 1 year following acceptance of the work.

2.2 TOPSOIL HANDLING AND STORAGE

Topsoil will be stockpiled at the Contractor's option, and at a location under his responsibility. Contractor will protect stockpiled topsoil from erosion by covering it in a manner approved by the Owner's Representative. The Owner's Representative will inspect and approve all materials prior to installation.

PART 3: EXECUTION

3.1 TOPSOIL LOCATIONS

Imported Topsoil will be placed in various locations on the project, as follows:

1. Fish Trap Structure
2. Channel Construction

3.2 PLACEMENT

- A. Install Topsoil in accordance with the Specifications and Plans. A minimum of 6 inches of Topsoil will be placed on all areas that require the placement of topsoil.
- B. Place Topsoil as directed by the Owner's Representative. Place Topsoil in lifts no greater than 6 inches and compact to 85% according to ASTM D698/AASHTO T99. Extreme care will be taken to avoid over-compaction of Topsoil. Soil moisture will be monitored, and adjusted if necessary, so that specified compaction is achieved. The Contractor will make every effort to keep Topsoil out of the stream.
- C. Before installing seed, till the Topsoil to a depth of 3 inches until soil attains a well-mixed, light, fluffed-up condition, free of large clods and clumps of vegetative material. Rake or drag area until surface is thoroughly settled with a smooth, firm surface, free of humps or hollows.

3.3 SUBMITTALS

Contractor will provide the following submittals for Imported Topsoil.

1. Name, address, and phone number of all Imported Topsoil suppliers, including location of the source.
2. Certified analysis of all Imported Topsoil to be used that show compliance with these Specifications.
3. Samples or arrange for a visit to the source by the Owner's Representative for approval for Imported Topsoil obtained off-site prior to delivery of materials.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Measurement of Imported Topsoil will be by the ton, according to weigh tickets provided to by the Contractor to the Owner's Representative.

4.2 PAYMENT

Payment for Imported Topsoil will be made at the unit price per ton. The unit price per ton for Imported Topsoil will constitute full compensation for all materials, labor, equipment, and incidentals necessary to furnish materials and for installation as specified in the specifications and on the Plans.

SECTION 02710 SEEDING

PART 1: GENERAL

1.1 DESCRIPTION

This work consists of ground surface preparation; furnishing and planting seed on areas of disturbed, bare soil within the project limits as described in these specifications or directed by the Owner's Representative.

The Contractor will make effort to minimize the spread of noxious weeds into the project site.

1.2 SUBMITTALS

Submit to the Owner's Representative applicable seed mixture certifications. Furnish duplicate signed copies of the vendors' statement certifying that each seed lot has been tested by a recognized seed testing laboratory within 6 months of date of delivery. Assure the statement includes: Name and address of laboratory, date of test, lot number for each seed species and the test results including name, percentages of purity and of germination, percentage of weed content for each kind of seed furnished and, for seed mixes, the proportions of each kind of seed.

PART 2: PRODUCTS

2.1 SEED

Furnish seed mixture, free of all prohibited noxious weed seed or any other weed seed prohibited by state or local ordinance. Do not use wet, moldy, or otherwise damaged seed in the work.

Seal and label all seed containers to comply with Montana Seed Law and Regulations, if shipped in interstate commerce. Furnish seed in standard containers labeled with the seed name, lot number, net weight, percentages of purity, germination, hard seed, and percentage of maximum weed seed content for each seed species. Furnish seed mixture of the following species:

| Seed Name | % Pure Live Seed | Lbs. Per Acre |
|----------------------|-------------------------|----------------------|
| Western Wheatgrass | 30 | * |
| Bluebunch Wheatgrass | 20 | * |
| Hard Fescue | 20 | * |
| Slender Wheatgrass | 15 | * |
| Green Needlegrass | 15 | * |

* Drilled Rate = 25 lbs/acre, Broadcast and Hydroseed Rate = 50 lbs/acre

PART 3: EXECUTION

3.1 ALLOWABLE SEEDING MONTHS

Perform seeding when the temperature and moisture are favorable to germination and plant growth. Seed after September 15th or according to a timeframe approved by the Owner's Representative. Seeding dates must be approved by the Owner's Representative.

3.2 SEEDBED PREPARATION AND SOWING

Clear the areas to be seeded of all debris, vegetation, and other material determined by the Owner's Representative to be detrimental to the preparation of a seedbed. Once the area is cleared, disc, harrow, rake, or work the area by other suitable methods, into a smooth, even seedbed. Assure the prepared seedbed surface is firm enough to prevent seed loss from high winds or normal rainfall. If rolling is required, perform rolling before seeding using a suitable roller, of a weight appropriate to the soil conditions.

Sow seed using hand broadcaster. Use equipment in good working order. Do not sow seed in winds that prevent proper embedment into the surface.

3.3 CARE OF SEEDED AREAS

Protect all seeded areas from traffic or pedestrian use with warning barricades or other Owner's Representative approved methods.

3.4 CONTROL OF UNDESIRABLE PLANT SPECIES

The Contractor will make reasonable efforts to control the introduction and spreading of undesirable plant species into the project area. Noxious weeds and other invasive species, include, but are not limited to Canada thistle, Musk thistle, Knapweed, Purple Loosestrife, Houndstongue, and Skeletonweed.

3.5 WARRANTY

The success criteria for areas that have been seeded are as follows.

- A. By June 2013, seeded areas will have 60% coverage with planted vegetation and no more than 10% of seeded areas should contain noxious weeds.
- B. By June 2014, or termination of the Owner's agreement with the landowner (whichever is first), seeded areas should have > 90% coverage with planted vegetation and noxious weeds occupying < 5% of the seeded area.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Seeding will be measured by the square yard and includes seedbed preparation and seeding, complete in place and accepted by the Owner's Representative.

4.2 PAYMENT

Payment for Seeding will be made at the unit price per square yard seeded as stated in the Bid.

Not in This Contract

SECTION 02725

DRAINAGE CULVERTS

PART 1: GENERAL

1.1 DESCRIPTION

- A. Furnish and install all drainage culverts and other appurtenant structures as specified in the Contract and this section. Pipe strength classifications are specified on the plans, listed in the Contract Documents or herein.

1.2 CERTIFICATION BY MANUFACTURER

- A. Furnish a manufacturer's certification on all pipe, certifying that the pipe and fittings meet the contract requirements.

1.3 REFERENCES

| | |
|-------------|--------------------------------------------------------------|
| AASHTO M 36 | Corrugated Galvanized Steel Pipe and Pipe Arches |
| AASHTO M218 | Galvanized Steel Coil |
| AASHTO M245 | Pre-Coated Galvanized, Corrugated Steel Pipe and Pipe Arches |
| AASHTO M274 | Type II Aluminized Corrugated Steel Pipe and Pipe Arches |
| AASHTO M294 | Corrugated Polyethylene Pipe (HDPE) |
| ASTM D361 | Low Head Pressure RCP |
| ASTM C76 | Reinforced Concrete Pipe |
| ASTM C443 | O-ring Rubber Gaskets |
| ASTM C506 | RCP - Arch Pipe |
| ASTM C507 | RCP - Elliptical Pipe |
| ASTM C655 | RCP - Tongue & Groove Pipe |
| ASTM C665 | RCP - D-Load Pipe |
| ASTM A761 | Corrugated Steel Structural Plate |
| ASTM C789 | Precast Reinforced Concrete Box Sections |
| ASTM C850 | Precast Reinforced Concrete Box Sections |

PART 2: PRODUCTS

2.1 GENERAL

- A. Furnish all culvert piping as specified in the Contract Documents and meeting the materials and testing requirements of this Section. Furnish the pipe sizes and strength classifications shown in the Contract documents.

- B. References to ASTM, ANSI or AASHTO designation, means the latest revision at the time of call for bids.
- C. Assure all pipe is clearly marked with type, class and/or thickness as applicable. Assure lettering is legible and permanent under normal handling and storage conditions.
- D. Furnish the joint type, class, thickness designation, casting, lining, marking, testing, etc. as specified.
- E. Culverts: Culverts shall be defined as open ended pipes in inlet or outlet control. If plastic pipe is used in Culvert applications, concrete headwalls or prefabricated metal end sections shall be used to protect the pipe ends from Ultraviolet Radiation. All culverts larger than 15-inch diameter shall have and treatments conforming to the embankment side slopes such as flared end terminal sections (FETS) or road approach culvert end treatment (RACET). The engineer shall determine if cut-off walls and edge protection are necessary to protect the installation from erosion.

2.2 PIPE MATERIALS

A. Concrete Pipe

- 1. Furnish reinforced concrete culvert pipe meeting ASTM C76, C506, C507 or C655. Use round reinforced pipe having O-ring rubber gasket joints meeting ASTM C443 with the O-ring gasket confined in the pipe tongue groove.

B. Corrugated Metal Pipe

- 1. Furnish corrugated metal pipe meeting ASTM A 760(AASHTO M36). Connections must be made with minimum coupling band width of 10-1/2". When specified by the Engineer, materials shall meet the following standards:

| | |
|------------------------|---------------------------------------------------------------------------------|
| ASTM A760 (AASHTO M36) | Specifications for Corrugated Steel Pipe, Metallic-coated for Sewers and Drains |
|------------------------|---------------------------------------------------------------------------------|

| | |
|-------------------------|------------------------------------------------------------------------------------|
| ASTM A762 (AASHTO M245) | Specifications for Corrugated steel Pipe, Polymer Pre-coated for Sewers and Drains |
|-------------------------|------------------------------------------------------------------------------------|

| | |
|-------------------------|--------------------------------------------------------------------------------------------------|
| ASTM A742 (AASHTO M246) | Specifications for Steel Sheet, Metallic Coated and Polymer Pre-coated for Corrugated Steel Pipe |
|-------------------------|--------------------------------------------------------------------------------------------------|

| | |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------|
| ASTM A929 (AASHTO M274) | Specifications for Steel Sheet Metallic Coated by the Hot Dip Process for Corrugated Steel Pipe. (Aluminized Type II) |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------|

C. An Owner may select other materials as appropriate for applications where an Engineer has reviewed the circumstances and provided specifications for installation. When specified by an Engineer, materials shall meet the following standards. Refer to

1.

| | |
|------------|------------------------------------------|
| ASTM A761 | Corrugated Steel Structural Plate |
| ASTM C 789 | Precast Reinforced Concrete Box Sections |
| ASTM C 850 | Precast Reinforced Concrete Box Sections |
2. Furnish HDPE Pipe with a corrugated exterior and a smooth interior waterway. Pipe must be made from virgin polyethylene (PE) compounds with dimensions and markings to conform to AASHTO M252, M294 and MP7. Pipe joints must meet ASTM E-1417 and ASTM D3212 standards for watertight joints.

| | |
|-------------|---------------------------------------|
| AASHTO M252 | Corrugated Polyethylene Drainage Pipe |
|-------------|---------------------------------------|

| | |
|-------------|----------------------------------------------|
| AASHTO M294 | Standard Specification for Polyethylene Pipe |
|-------------|----------------------------------------------|

| | |
|------------|-----------------------------------------------------------|
| ASTM D3350 | Standard Specification for Polyethylene Pipe and Fittings |
|------------|-----------------------------------------------------------|

| | |
|------------|--------------------------------|
| ASTM E1417 | Liquid Penetration Examination |
|------------|--------------------------------|

| | |
|------------|-----------------------------------------------------------------|
| ASTM D3212 | Joints for Sewer Plastic Pipes Using Flexible Elastomeric Seals |
|------------|-----------------------------------------------------------------|

PART 3: EXECUTION

3.1 PIPE INSTALLATION

A. Excavation and Backfill

1. Excavate and backfill culverts in accordance with manufacturers specifications and Standard Drawings No. 02725-1 and 02725-2 (MDT).

2. Bedding material and backfill around and over culverts shall be compacted to 95% of maximum laboratory dry density, ASTM D690 for all culverts installed in roadway embankments, unless specified otherwise by Engineer

B. Responsibility for Materials

1. Be responsible for all material furnished. Replace all material found defective in manufacture or damaged in handling after delivery by the manufacturer. This includes furnishing all material and labor required for the replacement of installed material discovered defective before final acceptance of the work or during the guarantee period.
2. Be responsible for the safe storage of material for the work until it has been incorporated in the completed project.

C. Handling of Pipe

1. Deliver and distribute all Contractor furnished pipe. Load and unload pipe, fittings and accessories by lifting with hoists or skidding so as to avoid shock or damage. Do not drop the materials. Do not skid or roll pipe handled on skidways against pipe already on the ground.
2. In distributing the material at the work site, unload each piece opposite or near the place where it is to be laid in the trench. Keep the pipe interior and other accessories free from dirt and foreign matter at all times.
3. Handle pipe to prevent coating or lining damage. Repair or replace all coating or lining damage in a manner satisfactory to the Engineer.

D. Laying Pipe.

1. Lay and maintain all pipe to the specified lines and grades with fittings, at the specified locations.
2. Use tools and equipment meeting Engineer approval for the safe and convenient prosecution of the work. Carefully lower all pipe and fittings into the trench preventing damage to pipe materials and protective coatings and linings. Do not dump or drop materials into the trench.
3. Exercise care to prevent foreign material from entering the pipe as it is installed. When pipe laying is not in progress, close the open ends of pipe using a plug or other means approved by the Engineer. Remove and clean

all sand, gravel, concrete and cement grout that has entered the lines during construction.

E. Tolerances

1. Install pipe within 1/2-inch (13 mm) of the specified alignment and within 1/4-inch (6 mm) of the specified grade for pipe 15-inch (38 cm) in diameter and smaller and 1/2-inch (13 mm) of specified grade for pipe larger than 15-inch (38 cm) diameter. These tolerances apply to any point along the entire pipe length.

3.2 TESTS

A. Visual Inspection

1. Inspect culverts for line, grade and roundness. Repair or replace culverts that are out of round, excessively deflected, or not installed to line and grade requirements.

B. Joints

1. All joints shall be silt tight joints to prevent infiltration and exfiltration of soil and water.

PART 4: MEASUREMENT AND PAYMENT

4.1 GENERAL

- A. The following are pay items for the work covered under this section. Payment for these items is full compensation for providing all materials, tools, labor and equipment necessary to complete the item and all incidental work related thereto, whether specifically mentioned herein or not.

4.2 CULVERTS

- A. Measurement of culvert piping is by lineal feet (meters) of the various sizes and classes along the centerline of pipe for the length of pipe installed, including flared ends. Payment for culvert piping is made at the contract unit price bid per lineal foot (meters), which includes furnishing and installing pipe, including any specials or flared end sections, trench excavation and backfill, and all other work necessary or incidental for completion of the item.

4.3 GENERAL

- A. The contract bid prices are full payment for all labor, materials, tools and other incidentals as maybe required to complete the items of work in the Contract.

END OF SECTION

Not in This Contract

SECTION 02750

CANAL GATES & APPURTENANCES

PART 1: GENERAL

1.1 WORK INCLUDES

Furnish and install two Waterman C-10 18-inch Canal Gates and one Waterman C-10 6-inch Canal Gate and appurtenances, including but not limited to frames, weir, gaskets, slides, thimbles, stems, guides, pedestals, and operators. Install canal gate per the Contract Documents.

1.2 REFERENCES

ANSI/AWWA C540-00 – Standard for Power-Actuating Devices for Valves and Slide Gates

ASTM A48 - Standard Specification for Gray Iron Castings

ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.

ASTM A582 - Standard Specification for Free-Machining Stainless Steel Bars Hot-Rolled or Cold-Finished.

ASTM B21- Standard Specification for Naval Brass Rod, Bar, and Shapes.

ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.

ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.

ASTM F594 - Standard Specification for Stainless Steel Nuts.

AWWA C560-00 - Standard for Cast-Iron Slide Gates.

1.3 SUBMITTALS

- A. Shop Drawings and Material Specifications: Prior to delivery to the site, submit certified shop drawings and material specifications of the equipment to be supplied in accordance with Sections 4.1 and 4.2 of AWWA C560-00. The shop drawings shall be in sufficient detail to determine if the proposed equipment meets these Specifications.
- B. Affidavit of Compliance: Submit an affidavit of compliance by the manufacturer with all applicable provisions of these Specifications.

1.4 MATERIAL STORAGE

Proper storage of materials is the responsibility of the Contractor, as is the protection from adverse conditions that would disqualify them from use under this specification.

PART 2: PRODUCTS

2.1 SLIDE GATES

- A. The slide gates shall be designed and fabricated in accordance with AWWA C560-00, Standard for Cast-Iron Slide Gates, and as shown on the Drawings. If there is conflict between AWWA C560-00 and this Specification, the latter shall govern.
- B. Slide gates, hoisting devices, and appurtenances including frames, slides, thimbles, lifts, stems, guides, and actuators shall be manufactured by Hydro Gate, Rodney Hunt Company, Waterman Industries, or approved equal.
- C. Materials: Conform to the following:
 - 1. Thimbles, frames, guides, slide, stem guides, and gear housings: Cast iron, ASTM A126, Class B, or ASTM A48, Class 30.
 - 2. Stems: Stainless Steel, ASTM A582, Type 303 or ASTM A276, Type 302 or 304.
 - 3. Stem Couplings: Stainless Steel - ASTM A582, Type 303 or ASTM A276 Type 302 or 304
 - 4. Wedges, Thrust Nut, Gate Actuator Lift Nut: Bronze, ASTM B584.
 - 5. Anchor Bolts and Fasteners: Stainless Steel, ASTM F593 or F594, Alloy Group 1 or 2.
 - 6. Seating Faces and Stem Guides: Bronze, ASTM B21.
 - 7. Stem Guide Bushings: Bronze, ASTM B584.
 - 8. Flush-bottom seal: Elastomeric materials - ASTM D2000.
 - 9. Flush Bottom Retainer Bar: Cast-iron - ASTM A126 Class B; Stainless steel- ASTM A582, Type 303 or ASTM A276, Type 302 or 304.
- D. Gate Frames and Slides
 - 1. Designed and Fabricated for a maximum seating head of 10 feet.
 - 2. Seating faces shall be made of bronze strips secured firmly in finished grooves in the frame and slide face.

E. Seals

1. Flush bottom seal shall be natural or synthetic rubber, designed for mounting on the frame, secured in place with bolted retainer bar, to provide an unobstructed flush invert.

F. Wedging Devices

1. Top Wedges shall be provided per AWWA 560-00, Section 4.4.8.

G. Wall Thimbles

1. Wall thimbles shall be Type "E", constructed of cast iron, with square front flange for connection to gate, round opening, and round back flange for connection to steel pipe flange.
2. The round back flange shall have an AWWA C207-01 Class B bolt pattern for attachment to steel pipe flange.

H. Stem and Stem Couplings

1. Rising stem shall be provided.
2. Couplings or splices for joining stem sections shall be of the same material as the stem and of greater strength than the stem.
3. Stop nuts or collars shall be provided on the stem to prevent the gate from over-closing and over-opening.
4. Each rising stem unit shall be provided with a stem cover made of clear plastic. The cover shall be clearly marked in 0.1 foot increments to show the position of the gate.
5. Stem critical buckling compressive load shall be designed with a safety factor of 3 instead of a safety factor of 2 described in AWWA 560-00, Section 4.4.11.2.

I. Stem Guides

1. Stem guide spacing shown on the Drawings is for illustration only. Stem guides shall be spaced in accordance with AWWA C560-00, Section 4.4.12.
2. Guides shall be fully adjustable, allowing lateral and perpendicular to the wall adjustment.

J. Lifting Devices

1. Lifting device shall be selected per supplier's recommendation.

K. Fabrication

1. All parts of slide gates, frames and accessories shall be accurately machined on mating bearing surfaces.
2. All like parts shall be interchangeable for ease of replacement.
3. All attaching bolt holes shall be drilled accurately to template to ensure alignment during field installation.
4. After painted surfaces are dry, the machined or bearing surfaces and holes, plain and threaded, shall be coated with protective grease until field installation.

L. Manufacturer Tests

1. The Buyer's Representative shall have entry at all times while tests are being conducted to ascertain that materials being furnished are in accordance with the Contract Documents.
2. Perform seat clearance check per AWWA 560-00, Section 4.5.2.1. After assembly with gate fully closed, verify clearance between seating faces. Clearances between seating faces shall not permit insertion of a 0.004-inch thickness gauge. If re-machining is required, retest clearances until they are correct.
3. After final assembly, all seating and wedging surfaces shall be cleaned and final adjustments made. The slide gates shall then be shop-operated from the fully closed to fully opened positions to verify the assembly is workable.

PART 3: EXECUTION

3.1 FIELD INSPECTION (SPECIAL SERVICES)

- A. At Owners cost and discretion, provide one day of on-site inspection and training by a manufacturer's representative after field installation of the slide gate is complete. The inspection will include verifying the gate has been properly installed and is operating correctly. Training should include appropriate procedures for operation and maintenance of slide gate and operator.

PART 4: MEASUREMENT AND PAYMENT

Payment for canal gates will be made under Section 02400 Fish Trap Structure.

END OF SECTION

SECTION 03210
REINFORCING STEEL

PART 1: GENERAL

1.1 DESCRIPTION

- A. This work is furnishing and placing reinforcing steel or wire fabric meeting the quality, type and size specified in the contract.

1.2 REFERENCES

| | |
|-------------|------------------------------------------------------------------|
| ASTM A-615 | |
| ASTM A-705 | |
| AASHTO M 31 | Deformed and Plain Billet-Steel Bars for Concrete Reinforcement |
| AASHTO M 32 | Cold Drawn Steel Wire for Concrete Reinforcement |
| AASHTO M 55 | Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement |
| AASHTO M 54 | Fabric Deformed Steel Bar or Rod Mats for Concrete Reinforcement |

PART 2: PRODUCT

2.1 Furnish all new material meeting the following requirements.

A. Bar Reinforcement

1. Furnish deformed reinforcement steel meeting ASTM A 615, (AASHTO M3 1) or ASTM A705, Grade 40 or Grade 60.
 - a. Small quantities purchased from warehouses may, at the Engineer's direction, be accepted if bend tested under ASTM A615 or AASHTO M31. The test specimen must cold bend around a pin without cracking on the outside of the bent portion.

B. Wire and Wire Mesh

1. Furnish wire meeting cold-drawn steel wire AASHTO M32 (ASTM A82) requirements.
2. Furnish wire mesh for concrete reinforcement meeting AASHTO M 55 (ASTMA A 185).

3. Furnish bar mats meeting AASHTO M54 (ASTM A 184).

PART 3: EXECUTION

3.1 PROTECTION

- A. Protect steel reinforcement from damage at all times. Place steel free from dirt, detrimental scale, paint, oil and other foreign substance. Clean steel reinforcement having easily removed rust, loose scale, and dust using an approved method.

3.2 FABRICATION

- A. Furnish four copies of shop details and placing drawings for all reinforcing steel to the Engineer for approval. Once checked, the Engineer will return two marked-up sets of prints or drawings for correction. The Engineer's review is only for general conformity with the plans. Checking the detailed dimensions is the Contractor's responsibility. The Engineer's review does not relieve the Contractor's responsibility to furnish all material meeting the Contract requirements. Detail Reinforcing, steel meeting the ACI "Standard Details and Detailing of Concrete Structures" and the "Manual of Engineering and Placing Drawings for Reinforced Concrete Structures" published by the American Concrete Institute (ACI 315).
- B. Assure all bars are bent cold. Do not field bend any bar partially imbedded in concrete except as specified on the plans.
- C. Ship bar reinforcement in standard bundles, tagged and marked meeting the "Details and Detailing of Concrete Structures" (ACI 315) requirements.
- D. Concrete reinforcement and accessory details, not covered herein or on the drawings, must meet "Details and Detailing of Concrete Structures" and the "Manual of Engineering and Placing Drawings for Reinforced Concrete Structures" (ACI 315 and 315R) requirements.

3.3 PLACING AND FASTENING

- A. Accurately place and hold firm all steel reinforcement in the plan locations as concrete is being placed.
- B. Support and fasten together all reinforcement to prevent displacement due to construction loads. It is permissible to use on ground, where necessary, concrete support blocks having a minimum 4 square inches (2580 MM²) bearing area and having a compressive strength equal to the concrete being placed. Use approved bar chairs and spacers over form work. For concrete surfaces exposed to the

weather in the finished structure, assure the portions of all accessories within ½-inch (12.7 mm) of the concrete surface are noncorrosive or protected against corrosion.

- C. Overlap welded wire fabric for successive mats or rolls providing an overlap measured between outermost cross wires of each fabric sheet at least 2 inches (50.8 mm). Extend the fabric across supporting beams and walls to within 4 inches (101.6 mm) of concrete edges. It may extend through contraction joints. Adequately support the fabric during concrete placement to maintain its position in the slab using the methods previously described or by laying the fabric on a concrete layer of the required depth before placing the upper slab layer.
- D. Offset vertical bars in columns at least one bar diameter at lap splices. Furnish templates for all column dowels.
- E. Obtain Engineer approval for all splices not shown on the plans. Mechanical connectors for reinforcing bars may be used if approved.
- F. Do not use pebbles, pieces of broken stone, concrete rubble, broken brick or building blocks, metal pipe, or wooden block to position the fabric.
- G. Follow the minimum concrete protective covering for reinforcement below.
 - 1. Concrete deposited against ground: 76.2 mm (3 inches)
 - 2. Formed surfaces exposed to weather or in contact with the ground:
 - a. #6 bars or larger 50.8 mm (2 inches)
 - b. Smaller than #6 bars 38.1 mm (1-1/2 inches)
 - 3. Interior Surfaces:
 - a. Beams, girders and columns 38.1 mm (1-1/2 inches)
 - b. Slabs, walls and joists:
 - 1) #11 bars or smaller 19.05 mm (3/4-inch)
 - 2) #14 and #18 bars 38.1 mm (1-1/2 inches)
- H. For corrosive atmospheres or fire protection, see special provisions for minimum covering requirements.
- I. Obtain Engineer approval of reinforcement placement before placing concrete. Remove and replace concrete placed without Engineer approval of reinforcing.
- J. Straighten fabric reinforcement shipped in rolls into flat sheets before placing it.

3.4 WELDING

- A. When specified or approved, weld reinforcing steel meeting “Reinforcing Steel Welding Code” (AWS D 1.1). Do not weld at bends in bars. Do not tack weld crossbars without Engineer approval.

PART 4: MEASUREMENT AND PAYMENT

4.1 GENERAL

- A. Reinforcing steel used in the work is not measured. The cost of furnishing and placing reinforcing steel is incidental and included in the unit price or lump sum price bid for various items of the work.

END OF SECTION

SECTION 03310

STRUCTURAL CONCRETE

PART 1: GENERAL

1.1 DESCRIPTION

- A. Furnish structural concrete meeting all specified requirements that is composed of Portland cement, aggregates, water. Furnish Ready-mixed concrete meeting ASTM C94 unless otherwise specified.

1.2 REFERENCES

| | |
|-------------|---------------------------------------------------------------------------------------------------------------|
| ASTM C-94 | Standard Specification for Ready-Mixed Concrete |
| ASTM C-150 | Specification for Portland Cement |
| ASTM C-618 | Specification for Coal Flyash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete |
| ASTM C-989 | Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars |
| ASTM C-595 | Specification for Blended Hydraulic Cements |
| ASTM C-157 | Performance Specification for Hydraulic Cements |
| ASTM C-33 | Specification for Concrete Aggregates |
| ASTM C-260 | Specification for Air-Entraining Admixtures for Concrete |
| ASTM C-494 | Specification for Chemical Admixtures for Concrete |
| ASTM C-1017 | Specification for Chemical Admixtures for Use in producing Flowing Concrete |
| ASTM D-98 | |
| ASTM C-138 | Test Method for Density(Unit Weight), Yield, and Air Content(Gravimetric) of Concrete |
| ASTM C-173 | Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method |
| ASTM C-231 | Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method |
| ASTM C-31 | Practice for Making and Curing Concrete Test Specimens in the Field |
| ASTM C-39 | Test Method for Compressive Strength of Cylindrical Concrete Specimens |
| ASTM C-172 | Practice for Sampling Freshly Mixed Concrete |
| ACI 301 | Standard Specification for Structural Concrete for Buildings |
| ACI 305 | Hot Weather Concrete |
| ACI 306 | Cold Weather Concrete |
| ACI 318 | Building Code Requirements for Reinforced Concrete |

1.3 QUALITY ASSURANCE

- A. Codes and Standards: The codes and standards referred to in this section are declared to be part of this specification as if fully set forth herein. In addition, the following ACI Standards are incorporated in their entirety, unless specifically required otherwise:
1. ACI Standard 301, "Specifications for Structural Concrete for Buildings," American Concrete Institute, Edition.
 2. ACI Standard 318, "Building Code Requirements for Reinforced Concrete", American Concrete Institute, current edition.
 3. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
 4. International Building Code of I.C.B.O.
- B. Concrete Testing: The Contractor shall employ at his expense a testing laboratory acceptable to the Engineer to perform material evaluation tests and/or perform the mix design prior to placing any concrete. The Engineer will perform all acceptance testing during the onsite placement of the concrete .. Retesting or additional testing of concrete or materials failing to meet the requirements of these specifications shall be done by the Contractor at no additional cost to the Owner.

PART 2: PRODUCT

2.1 CLASSIFICATION

- A. Concrete is classified as set forth below. Place the specified class of concrete for each structure element as specified. Concrete with prefixes "C" contain 1-1/2 inch (38.1 mm) size aggregate and those with "M" contain 3/4 inch (19.05 mm) size aggregate.. Concrete with prefixes "M" may be substituted for concrete with prefixes "C."
1. Use M-4000 concrete for curb and gutter, sidewalks, driveways, approaches, curb turn fillets and valley gutters and structural concrete.
 2. Use M-3000 concrete for manholes, storm drain inlets and miscellaneous or C-3000 Concrete Construction class.
 3. M-3000 is concrete with 3/4 inch (19-05 mm) maximum aggregate and a 28-day compressive strength of 3000 pounds per square inch (psi) (20.7 Mpa).

4. M-4000 is concrete with 3/4 inch (19-05 mm) maximum aggregate and a 28-day compressive strength of 4000 pounds per square inch (psi) (27.6 Mpa).
 5. C-3000 is concrete with 1-1/2 inch (38.1 mm) maximum aggregate and a 28-day compressive strength of 3000 psi (20.7 Mpa).
- B. If concrete strength or durability requirements established by design exceed the above strength classifications, the Engineer may specify additional concrete classifications to meet those requirements.

2.2 COMPOSITION OF CONCRETE

- A. Upon receipt of the notice of award of the contract, furnish the Engineer with names of suppliers and locations of sources of materials proposed for use.
1. Materials
 - a. Cementitious Material: Cementitious material consists of Portland cement meeting ASTM C 150, with or without the addition of cementitious or pozzolanic mineral admixtures meeting, ASTM C618 or ASTM C989, or blended hydraulic cement meeting ASTM C595 or hydraulic cement meeting ASTM 1157. Unless otherwise specified, assure cementitious material meets ASTM C 150 Type I or Type II. Assure cementitious material used in concrete is the same brand and type and from the same plant of manufacture as the cementitious material used in the concrete represented by the submitted field test data or used in the trial mixtures.
 - b. Aggregates: Assure aggregates meet ASTM C33. When a single size or a combination of two or more sizes of coarse aggregates are used, assure the final gradation meets the grading requirements of ASTM C33. Obtain concrete aggregates from the same source and use the same size ranges as the aggregates used in the concrete represented by submitted historical data, or used in trial mixtures.
 - c. Water and Ice: Use concrete mixing water and water to make ice meeting requirements of ASTM C94.
 - d. Admixtures: Use admixtures meeting the following requirements:
 - 1) Air entraining, admixtures - ASTM C260
 - 2) Chemical admixtures- ASTM C494

- 3) Chemical admixtures for use in producing, flowing concrete- ASTM C1017
- 4) Calcium Chloride - ASTM D98
- 5) Use admixtures in the concrete that are the same as those used in the concrete represented by submitted field test data or in trial mixtures.

2. Change of materials

- a. When brand, type, size, or source of cementitious materials, aggregates, water, ice or admixtures are requested to be changed, submit new field data or data from new trial mixtures or furnish evidence that indicates that the change will not adversely affect the relevant properties of the concrete for acceptance before using the concrete.

B. Performance and Design Requirements

1. Assure the cementitious material content is adequate to meet the specified requirements for strength, water-cement ratio and finishing requirements. For concrete used in floors, assure the cement content is at least that indicated in Table 2.1. For concrete exposed to freezing and thawing or concrete exposed to deicers, assure a maximum water-cement ration of 0.45.

TABLE 2.1
MINIMUM CEMENT CONTENT REQUIREMENTS

| Nominal Maximum size of aggregate, in(mm) | Minimum cement content lb/yd ³ (kg/m ³) |
|----------------------------------------------|-------------------------------------------------------------------|
| 1-1/2 (38-1) | 470* (163.0) |
| 1 (25.4) | 520 (180.3) |
| 3/4 (19-05) | 540 (187-3) |
| 3/8 (9-5) | 641 (222.3) |

* Minimum cement content is 520 lb/yd³ (180.3 kg/m³) and maximum H₂O/cement ratio of 0.45 if concrete will be exposed to freezing and thawing and/or in the presence of deicing chemicals.

2. Furnish concrete at the point of delivery having a slump of 4 inches (max) (100 mm) determined by ASTM C 143. Meet slump tolerances in ACI 117. When a plasticizing admixture is used meeting ASTM C 10 17 or when a Type F or G high range water reducing admixture meeting ASTM C494 is approved to increase the concrete slump, assure the concrete has a slump

of 2 to 4 inches (50-100mm) before the admixture is added and a maximum slump of 8 inches (200 mm) at the point of delivery after the admixture is added.

3. Assure the nominal maximum size of coarse aggregate does not exceed three fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms or one-third of the thickness of slabs or toppings.
4. Concrete must be air entrained. Measure air content under ASTM C 138, C 173 or C231. Unless otherwise specified, ASTM C231 shall be used.

TABLE 2.2
TOTAL AIR CONTENT* OF CONCRETE
FOR VARIOUS SIZES OF COARSE AGGREGATE

| Nominal maximum Size of aggregate mm, (in.) | Total air content, percent | | |
|------------------------------------------------|----------------------------|----------------------|------------------|
| | Severe exposure | Moderate exposure | Mild exposure |
| Less than 9.53(3/8) | 9 | 7 | 8 |
| 9.53 (3/8) | 7.5 | 6 | 4.5 |
| 12.5(1/2) | 7 | 5.5 | 4 |
| 19 (3/4) | 6 | 5 | 3.5 |
| 25.4(1) | 6 | 4.5 | 3 |
| 12.7(1-1/2) | 5.5 | 4.5 | 3 |
| 50.8(2) | 5 | 3.5 | 1.5 |
| 76.2(3) | 4.5 | 3.5 | 1.5 |
| 152.4(6) | 4 | 3 | 1 |

* Measure in accordance with ASTM C 138, C 173, or C 231.

Air content tolerance is +/- 1 1/2 percent

- a. When admixtures are specified in the Contract documents for particular parts of the work, use types specified. Use of calcium chloride or other admixtures containing chloride ions is subject to the limitations in Table 2.3 Chloride Ion Concentration. When approved, use calcium chloride in solution form only, when introduced into the mixture.
 - 1) Assure the maximum water soluble chloride ion concentrations in hardened concrete at ages from 28 to 42 days attributed to the ingredients including water, aggregates, cementitious materials and admixtures do not exceed the limits of Table 2.3. Use tests to determine water soluble chloride ion content meeting AASHTO T260. The

type of member described in Table 2.3 applies to the work as indicated in the Contract Documents.

TABLE 2.3
MAXIMUM ALLOWABLE CHLORIDE ION CONTENT

| Type of Member | Maximum water soluble chloride (CI) Content in concrete, percent by weight of cement |
|----------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Prestressed concrete | 0.06 |
| Reinforced concrete exposed to chloride in service | 0.15 |
| Reinforced concrete that will be dry or protected from moisture in service | 1.00 |
| Other reinforced concrete construction | .30 |

- b. When the average of the highest and lowest temperature during the period from midnight to midnight is expected to drop below 40°F (40°C) for more than three successive days, deliver concrete in accordance with ASTM C-94.
- c. Furnish the compressive strength and the water-cement or water cementitious, material ratio of concrete for each portion of the work as specified in the Contract documents.
 - 1) If cementitious or pozzolanic mineral admixtures meeting, ASTM C618 or ASTM C989 are used, the cement portion of the water-cement ratio must be the total weight of cementitious material.
 - 2) The maximum weight of fly ash, pozzolan or ground granulated blast-furnace slag included in the calculation of water-cementitious material ratio cannot exceed the following percentages of the total weight of portland cement plus fly ash, pozzolan and ground granulated blast-furnace slag:
 - 3) The combined weight of fly ash and pozzolan meeting ASTM C618 cannot exceed limits in ACI 318.. The fly ash and pozzolan present in an ASTM Type IP or IPM blended cement meeting ASTM C595 must be included in the calculated percentage.
 - 4) The weight of ground granulated blast-furnace slag meeting ASTM C989 cannot exceed 50 percent of the total weight

of cementitious material. The slag used in manufacture of a Type IS or ISM blended hydraulic cement meeting ASTM C595 must be included in the calculated percentage.

- 5) If fly ash or pozzolan is used in concrete with ground granulated blast-furnace slag, the portland cement constituent meeting ASTM C 150 cannot be less than 50 percent of the total weight of cementitious material. Fly ash or pozzolan must not constitute more than 25 percent of the total weight of cementitious material.
- 6) Strength requirements are based on the 28-day compressive strength determined on 6" x 12" (150mm x 300mm) cylindrical specimens made and tested under ASTM C31 and C39 respectively.

2.3 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to the Engineer for preparing and reporting proposed mix designs.
- B. Submit written reports of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed and approved.

PART 3: EXECUTION

3.1 CONCRETE MIXES

- A. Job-Site Mixing: Mix materials for concrete in appropriate drum type batch match mixer. For mixers of one cu. Yd., or small capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cu. Yd., increase minimum 1-1/2 minutes of mixing time by 2.5 minutes for each additional cu. yd., or fraction thereof.
- B. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, batch quantities, and amount of water introduced.
- C. Ready-Mix Concrete: Comply with requirements of ASTM C94, and as herein specified.

- D. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ANSI/ASTM C94 may be required.
- E. When air temperature is between 85°F (30°C) and 90°F (32°C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90°F (32°C), reduce mixing and delivery time to 60 minutes.

3.2 CONSISTENCY

- A. Assure concrete is of such consistency that it will flow around reinforcing steel, but individual particles of the coarse aggregate, when isolated, show a coating of mortar containing its proportionate quantity of sand. The consistency of the concrete will be gauged by the ability of the equipment to properly place the concrete in its final position and not by the difficulty in mixing or transporting. Use the minimum quantity of mixing water necessary to provide workability within the ranges of slump specified.

3.3 MIXING

- A. Thoroughly mix concrete to assure a uniform distribution of the materials throughout the mass. Mix concrete only in quantities required for immediate use and place it within the time limits specified. Waste all concrete which initial set has begun. Retempering of concrete is prohibited. Aggregates, or bags of cement containing lumps or crusts of hardened material shall not be used. Mix concrete in an approved truck mixer meeting the requirements of ASTM C94 herein.
- B. The capacity of the plant and the transportation equipment must ensure delivery at a rate that will permit proper handling, placement and finishing at the point of delivery. Maintain the concrete delivery rate to provide for the continuous operation of placing, handling and finishing concrete as is practical. Maintain the interval between delivery of loads so that layers or lifts of concrete in place do not harden before succeeding layers or lifts are placed. In general, no lift or layer of concrete can remain exposed for more than 20 minutes before being covered by fresh concrete.
- C. The volume of mixed concrete in the mixing drum shall not exceed the manufacturer's rating, on the capacity plate.
- D. During freezing weather, other approved methods of measuring water will be permitted.
- E. A recording water metering device is always required at the primary point of the batching operation.

- F. Do not add water to concrete in transit. Water may be introduced into the mixer at the job site under direction of the Engineer, if the specified water-cement ratio is not exceeded. Water must be added in accordance with ASTM C94, Assure the drum revolves continuously after the introduction of the cement and water until the concrete is discharged.
- G. Begin mixing immediately after introduction of the cement and water and continue for at least 70 revolutions of the drum at mixing speed. This minimum revolution count will be waived when the concrete is produced at a central mixing plant. Not more than 100 drum revolutions can exceed 6 revolutions per minute. All other revolutions must be at agitating speed of not less than 2 or more than 6 revolutions per minute.
- H. Discharge the concrete at the job and place in its final position within 1- 1/2 hours after the introduction of the mixing water and cement. When the air temperature is 90°F (30°C) or above, place the concrete in its final position within 1 hour after the introduction of the mixing, water and cement. Concrete mixes with an approved set retarding admixture may be held an additional ½ hour beyond limits specified above.
- I. No mixed or agitated concrete that has remained in the drum of the truck mixer more than 10 minutes without agitation can be used. If the Engineer determines the concrete has not suffered any detrimental effects. It may be used, after remixing for a minimum of 20 revolutions of the drum at mixing speed, if it can still be placed in the forms within the specified time limits.
- J. Provide a revolution counter on each truck that registers the number of revolutions of the drum.
- K. Mount the counter so it can be easily read by both the operator and the Engineer.

3.4 PLACING CONCRETE

- A. Thoroughly compact concrete into its final position. Assure it is thoroughly consolidated around fittings and embedded items. Assure all reinforcement and embedded items are accurately placed as shown on the plans and are clean and free from coatings of dried mortar, detrimental rust, scale, oil or foreign matter. Place concrete meeting the applicable requirements of Sections 02528 and 02529.

3.5 CURING CONCRETE

- A. Thoroughly cure concrete surfaces subject to premature drying by covering as soon as possible with canvas, plastic sheets with sealed joints, burlap and sand or other satisfactory materials and keep concrete moist. If the concrete surfaces are not covered, keep them moist by flushing or sprinkling. Continue curing for at

least 7 days after placing the concrete. Concrete surfaces placed against forms may be cured by leaving the forms in place for at least 7 days, when approved.

- B. Protect concrete against freezing or other conditions detrimental to strength development meeting the applicable requirements of this specification.
- C. To aid finishing, side forms on ornamental work, curbs and sidewalks, railing and parapets may be removed after 12 hours, not to exceed 48 hours, depending on weather conditions. Continue moist curing during the concrete finishing operation.
- D. Untreated forms and existing concrete must be kept continuously wet for at least 1 hour before any concrete is placed. Keep wet until covered with concrete except that adequately treated forms must be thoroughly washed with a water spray immediately before placing the concrete.
- E. The curing of concrete, by either water curing or membrane curing, must be as follows unless otherwise approved by the Engineer.

1. Water Curing

- a. Keep all concrete top surfaces continuously moist after finishing, with a fine water spray, until the concrete has set. Cover the moist concrete with water or an approved curing covering.
- b. Cure concrete deck slabs and concrete floors for at least 7 days. Cure by placing burlap, cotton mats or other absorptive material as close behind the finishing operation as possible without marring the finished surface. Keep the absorptive material continuously moist for the full time it is used. The absorptive material may be kept in place for the entire curing period or it may be removed as soon as practical and the entire surface covered with approximately 1-1/2 inches (38.1 mm) of sand, kept continuously moist for the entire curing period.
- c. Remove forms and repair surface irregularities without interfering with any of the curing requirements. As soon as the vertical forms have been removed and the surface irregularities repaired, cover the concrete with absorptive material, kept continuously wet for the balance of the curing period.

2. Impervious Membrane Curing

- a. Assure membrane curing compounds are delivered to the job in the manufacturer's original container, clearly labeled to show the name of the manufacturer and the contents. The clear curing

compound must be sufficiently transparent and free from permanent color that would change the color of the natural concrete. Use clear compound containing a fugitive dye having color sufficient to render the film visible on the concrete for at least 4 hours after application. The concrete surface must maintain its natural color after curing.

- b. Use a compound ready for use as shipped by the manufacturer. Dilute following the manufacturer's recommendations. Use curing compound only with written approval. Sampling will not be required if manufacturer's certification is available. Apply the curing compound under pressure with a spray nozzle to cover the entire exposed surface thoroughly and completely with a uniform film not exceeding manufacturer's specifications. Maintain the required pressure in the spray machine to force the material to leave the nozzle in a fine mist. Keep all concrete surfaces moist with a fine water spray or with wetted burlap until the sealing compound is applied. Keep the curing compound application close to the finishers of the top surface of concrete at all times. Seal the concrete immediately after the finishing operations have been completed, to the satisfaction of the Engineer.
- c. If it is necessary to allow workers or equipment on the surface before the 7 day curing period is completed, cover the top surface of sealed concrete with a protective cushion for runways. Use a cushion consisting of a moist, 1 –inch (25mm) minimum thick layer of fine sand, or layers of moist burlap that will prevent damage to the finished concrete. Cover the approved cushion with four by eight foot sheets of 3/4 inch(19mm) plywood laid over the cushion. Do not place the cushion material for at least 8 hours after the final application of the curing compound. Obtain the Engineer's written approval for any other proposed cushion material before use. Layers of plastic, visqueen or canvas are not an acceptable cushion material.
- d. Keep concrete, which has not completed its curing period, continuously moist during the stripping and surface repair operations. Remove all surface irregularities, repair all depressions, voids or holes, including those formed by trapped air, to the satisfaction of the Engineer. Immediately apply the curing compound before the surface has had an opportunity to dry out. Keep concrete, from which forms have been stripped, continuously moist until surface repair and finishing are completed and the impervious membrane curing has been applied.

3.6 WEATHER AND NIGHT LIMITATIONS

A. General

1. Stop concreting operations when darkness prevents obtaining the specified placing, and finishing work. Night operations may be conducted with written approval and when approved artificial lighting is provided.
2. Cold weather concreting is governed by ACI 306 unless otherwise specified herein. Hot weather concreting methods is governed by ACI 305 unless otherwise specified herein. Except by specific written authorization, stop concreting operations when a descending air temperature in the shade and away from artificial heat falls below 40°F (4°C), or do not resume until an ascending air temperature in the shade and away from artificial heat reaches frozen foundation course or subgrade.
3. Assume all risk of placing concrete in cold weather. Placing concrete during cold weather does not relieve the Contractor of the responsibility for obtaining the specified results. Remove and replace all concrete injured by frost at Contractor expense.
4. Before any concrete is placed, remove all ice, snow and frost completely from the formwork receiving the concrete.
5. Heating and Placing Concrete
 - a. When concreting is authorized during cold weather, assure concrete temperature meets ASTM C94.
6. Protection of Concrete
 - a. During the curing period, if the air temperature is anticipated to fall below 32°F (0°C, provide an approved blanket type insulating material along the work for covering all concrete that has been in place for 7 days or less. If, at any time, the ambient temperature drops to 32°F(0°C) or less, protect the concrete using a method approved by the Engineer. The minimum method of protection under such conditions is as follows: between two layers of plastic sheeting, the insulating materials, with the exception of commercial blankets, must be spread loosely to a minimum depth of 6 inches (150mm), but in all cases, to the depth required to prevent freezing of, or frost damage to, the concrete. Maintain the blanketing material at least until the end of the regular specified curing, period which is not less than 7 days. The Engineer may direct leaving the blanketing material in place for an additional

period if the recorded temperatures indicate that additional curing may be necessary. If during the construction period the mean daily temperature is expected to fall below 40°F(4°C) for 3 consecutive days, furnish approved heating enclosures and devices capable of maintaining the surface temperature of the concrete in place between 55°F (13°C) and 80°F (26°C). The curing, period under these conditions is 7 days when Type I-II cement is used and 5 days when a pre-approved "high early strength" mix is used. At the close of the curing period, the heat may be reduced so that the temperature inside the housing does not decrease faster than 15° per hour until the temperature inside the housing is the same as outside.

- b. A Contractor may, at their own expense, field cure concrete cylinders with their in-place concrete and discontinue protection when those field cylinders reach 70 percent of design strength as indicated by the 28 day requirement of these specifications.
- c. Perform all concrete protection using methods consistent with ACI-306-1-87 and approved by the Engineer.

3.7 TESTING

- A. All concrete must be tested by an ACI Grade I or equivalent certified testing technician. Unless otherwise specified, the engineer shall be responsible for all acceptance testing during the on-site placement of the concrete.
 - 1. Materials
 - a. The Engineer or their representative must have access to the ready mix production facility for sampling constituent materials during production to assure the materials meet these specifications and represent those stated on the approved mix design.
 - 2. Standard Slump Tests
 - a. The Engineer shall , during each day's placement, check the consistency of the concrete by slump test. A slump test will also be made each time that strength specimens are made . Slump tests are performed meeting ASTM C143"Method of Test for the Slump of Portland Cement Concrete".

3. Compression Tests

- a. A minimum of three specimens, 6 inch (150 mm) in diameter or 4 inch (100 mm), shall be made and tested for every concrete placement. Mold and test one set of test cylinders for every 100 yards (76.5 cubic meters) of concrete or fraction thereof placed each day. On a given project, if the total volume of concrete is such that frequency of testing required above would generate less than 5 strength tests for a given class of concrete, make tests from at least 5 randomly selected batches or from each batch if fewer than 5 batches are used. Cure these cylinders under laboratory conditions except that additional test cylinders cured entirely under field conditions may be required by the Engineer to check the adequacy of curing and protection of the concrete.
- b. Take samples for strength tests in accordance with ASTM C172, entitled "_____".
- c. Mold test cylinders and laboratory-cure in accordance with ASTM C31. Test cylinders in accordance with ASTM C39, entitled "Method of Test for Compressive Strength of Cylindrical Concrete Specimens", ASTM C39, using an independent testing laboratory, as approved by the Engineer.
- d. Of each of the 3 cylinders take for a pour, test 1 for information strength at 7 days and test 2 for acceptance strength at 28 days. To meet this specification, average strength of two cylinders from the same sample, tested at 28 days or the specified earlier age, is required for each strength test. Strength level of an individual class of concrete is considered satisfactory if both of the following requirements are met:
 - 1) The average of all sets of 3 consecutive tests equal or exceed the specified strength.
 - 2) No individual strength test (average of two cylinders) falls below specified strength by more than 500 psi (3400 kPa).
- e. Cure field cured cylinders under field conditions meeting Section 7.4 of "Method of Making and Curing Concrete Test Specimens in the Field" (ASTM C31).
- f. Mold field cured test cylinders at the same time and from the same samples as laboratory cured test cylinders. Improve procedures for protecting and curing concrete when strength of field cured cylinders at the test age designated for measuring specified

strength is less than 85 percent of that of companion laboratory cured cylinders. When laboratory cured cylinder strengths are appreciably higher than the specified strength, field cured cylinder strengths need not exceed the specified strength by more than 500 psi (3400 kPa) even though the 85 percent criterion is met.

- g. The strengths of any specimens cured on the job are to indicate the adequacy of protection and curing of the concrete and may be used to determine when the forms may be stripped, shoring removed or the structure placed in service. When the strengths of the job cured specimens are below those specified above, the Contractor must improve the procedures for protecting and curing the concrete.
- h. When concrete fails to meet the requirements above or when tests of field cured cylinders indicate deficiencies in protection and curing, the Owner's representative may order tests on the hardened concrete under Chapter 17.3 of ACI-301-84 or order load tests in Chapter 20 of the ACI Building Code (ACI 318-83) for that portion of the structure where the questionable concrete has been placed. In the event the load or core tests indicate that the structure is unsatisfactory, make all modifications as directed by the Engineer to make the structure sound. If the load or core tests indicate the concrete is satisfactory, all cost of testing shall be paid by Owner.

4. Air Content Tests

- a. The Engineer shall during each strength test, check the air content by either the "Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method" (ASTM C23 1), "Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method" (ASTM C173) or "Method of Test for Unit Weight, Yield and Air Content (Gravimetric) of Concrete" (ASTM C138)

5. Temperature

- a. Test hourly when air temperature is 40°F (4°C) and below, and when 80°F (27°C) and above; and each time a set of compression test specimens is made.

PART 4: MEASUREMENT AND PAYMENT

4.1 GENERAL

- A. The method of measurement and basis of payment is as outlined in the specifications for the various items of concrete work.

4.2 REQUIRED SUBMITTALS

- A. The following are submittals required to become an approved source of supply for Portland Cement concrete placed in the City right-of-way:

1. Complete concrete mix design meeting all specification requirements. Meet the Mix proportions specified in ACI 301, Chapter 3. Submittals will include the following:

MIX PROPORTIONS

| | |
|---------------------------------------------------------|---------------------------|
| -cement in lbs (kgs) | Type and source of supply |
| -coarse aggregate | Size and source of supply |
| -fine aggregate | Source of supply |
| -water, gallons(liters) | City or well |
| -admixtures,oz/yd ³ (g/M ³) | Brand and description* |

*description as retarder, accelerator, air entraining, etc.

B. MATERIALS INFORMATION

1. Specific gravity (bulk s.s.d. Basis) of coarse and fine aggregate and 1 percent absorption-coarse aggregate unit weight (dry-rodded)-ASTM C33 quality tests including the following:
- a. Fine aggregate
- 1) gradation AASHTO, T27 and T11 deleterious substances soundness (AASHTO T104) organic impurities (AASHTO T21) mortar-making properties (AASHTO T71)
- b. Coarse aggregate
- 1) deleterious substances gradation (AASHTO T27 and T11) soundness (AASHTO T104) percentage of wear (AASHTO T96)
- c. Current chemical analysis of mixing water (if well)

- d. Current cement mill analysis

2. CONCRETE MIX DATA

- a. slump
- b. % air
- c. unit weight
- d. 7 and 28 day compressive strength

3. VARIATIONS

- a. The following variations will be cause for submittal of a new mix design.
 - 1) Change of aggregate source
 - 2) Change of cement content
 - 3) Addition or exclusion of certain admixtures including, but not limited to, pozzolans, accelerators, retarders and water reducers
 - 4) Change in aggregate size
 - 5) Change in type of cement
 - 6) Failure to attain strength requirements as outlined in ACI 214 or ASTM C94
- b. A variation in any of the following will require 'Informing the City Engineer and possibly data indicating acceptability for use in existing mix designs.'
 - 1) Change of cement supplier
 - 2) Change of admixture brands or dosages (not types)
 - 3) Minor adjustments of aggregate proportions accompanying materials changes or to accommodate placement conditions (same w/c ratio)

C. Certification of Ready Mixed Concrete Production Facilities

- 1. Concrete producers are to allow access to their facilities by Engineer or their representatives for inspecting their facilities and/or sampling materials. All facilities should meet the requirements of the "National Ready-Mix Concrete Association" check list for concrete production facilities.

2. Items directly affecting a facility's ability to properly proportion, transport and deliver concrete may be reason for disqualifying that facility as a source of supply until such deficiencies are corrected. Examples would include cement and aggregate scales that will not accurately weight materials or mixer units that will not thoroughly mix concrete materials.
- D. The following chart indicates the submittal frequency for each item required for approval as a source of supply.

TABLE 4.1
SUBMITTAL FREQUENCY

| SUBMITTAL | FREQUENCY | | |
|------------------------------------|-----------|--------------|--------------------|
| | Monthly | Twice Yearly | Other |
| 1- Complete mix design | | | (See Item 1, No 4) |
| 2. Aggregate gradations | X | | With mix design |
| 3. L.A. Abrasion | | | With mix design |
| 4. Soundness | | | With mix design |
| 5. Deleterious substances | | | With mix design |
| 6. Water quality (if well) | | X | |
| 6a. Cube strengths and time of set | | | With mix design |
| 7. Cement mill certificates | X | | |
| 8. Organic Impurities | | | With mix design |
| 9. Inspection of facilities | | | As indicated |

Note: The above chart applies to the first year of this program. Frequency of submittals may change as dictated by variations of test data.

END OF SECTION